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THESIS

ASSESSMENTS IN THE GLOBAL PEACE OPERATIONS INITIATIVE: A SYSTEMS ENGINEERING APPROACH

by

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June 2014

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13. ABSTRACT (maximum 200 words)

This thesis decomposed the problem of operational assessments within the Global Peace Operations Initiative (GPOI) and then proposed a comprehensive framework to better address the challenge. This analysis was conducted for the United States Southern Command but is generalizable to other GPOI implementers, including other combat commands as well as State Department offices. The problem space was considered using standard systems engineering techniques such as stakeholder and functional analyses. Given the complex and ill-defined nature of the problem, systems architecting methods were applied to lend structure to the solution space; specifically, a capabilities-based architecture, adapted from an existing IT model, was used to generate a coherent framework. The proposed architecture balanced technical and non-technical elements of the system and provided a means to develop appropriate metrics that were traceable to the stated objectives and outcomes. The assessment framework was built from a systems engineering viewpoint; however, several heuristics from the field of operational assessments were also employed to provide additional practical improvements. The findings proposed that the GPOI adopt a coherent assessment framework that emphasizes traceability of all metrics and a more complete measurement of the GPOI system.

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This thesis decomposed the problem of operational assessments within the Global Peace Operations Initiative (GPOI) and then proposed a comprehensive framework to better address the challenge. This analysis was conducted for the United States Southern Command but is generalizable to other GPOI implementers, including other combat commands as well as State Department offices. The problem space was considered using standard systems engineering techniques such as stakeholder and functional analyses. Given the complex and ill-defined nature of the problem, systems architecting methods were applied to lend structure to the solution space; specifically, a capabilities-based architecture, adapted from an existing IT model, was used to generate a coherent framework. The proposed architecture balanced technical and non-technical elements of the system and provided a means to develop appropriate metrics that were traceable to the stated objectives and outcomes. The assessment framework was built from a systems engineering viewpoint; however, several heuristics from the field of operational assessments were also employed to provide additional practical improvements. The findings proposed that the GPOI adopt a coherent assessment framework that emphasizes traceability of all metrics and a more complete measurement of the GPOI system.

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LIST OF ACRONYMS AND ABBREVIATIONS

AOR	area of responsibility
EMMI	energy, matter, material wealth, and information
FFBD	functional flow block diagram
DOD	(U.S.) Department of Defense
DODAF	Department of Defense Architecture Framework
DOS	(U.S.) Department of State
DSCA	Defense Security Cooperation Agency
DOTMLPF	doctrine, organizations, training, materiel, leadership development, personnel, facilities
ICAM	integrated computer aided manufacturing
IDEF0	ICAM definition for functional modeling
IT	information technology
FTC	full training capability
FPU	formed police unit
GCC	GPOI Coordination Committee
GIG	GPOI Implementation Guide
GPOI	Global Peace Operations Initiative
GRC	GPOI Regional Committee
G8	Group of Eight (Canada, France, Germany, Italy, Japan, Russia, United Kingdom, United States)
MBSE	model based systems engineering
MMU	Manchester Metropolitan University
MOA	memorandum of agreement
MOD	Ministry of Defence (United Kingdom)
MOE	measure of effectiveness
MOI	measure of input
MOP	measure of performance
MOPr	measure of process
MORS	Military Operations Research Society
MORSS	Military Operations Research Society Symposium

MOU	memorandum of understanding
MOVES	Modeling, Virtual Environment and Simulation
M & S	modeling and simulation
NPS	Naval Postgraduate School
OV-1	hi-level operational concept graphic (from DODAF)
OV-2	operational node connectivity description (from DODAF)
PKO	peacekeeping operations
PM	program manager
POL-MIL	political-military (group)
POR	program of record
SE	system(s) engineer (or engineering)
SYSML	systems modeling language
TSCMIS	Theatre Security Cooperation Management Information System
UML	Unified Modeling Language
UN	United Nations
U.S.	United States
USAFRICOM	Unites States Africa Command
UN DPKO	United Nations Department of Peacekeeping Operations
USSOUTHCOM	United States Southern Commanded

EXECUTIVE SUMMARY

This research offers three principal families of recommendations to improve assessments in the Global Peace Operations Initiative (GPOI). The first recommendation is simply to base measurements on stated objectives and end states, which is an expression of the basic systems engineering concept of traceability. Secondly, this research advocates that the stakeholders think in a more holistic manner that should be exhibited both by broadening the solution space beyond technical means to include organizational dynamics, as well as understanding that to assess any given element of a system likely requires the measurement of its connections with other system elements. Thirdly, given the complexity and ill-defined nature of the problem, this research advises the application of systems architecting to provide a structured framework from which measurement models can then be derived.

When viewed as a system, the problem facing the GPOI is a deficient feedback mechanism. This lack of feedback makes difficult both the day to day operations of guiding investments as well as the task of explaining and justifying the program's impact to resource sponsors. This research has concluded that the GPOI Assessments framework operates primarily at the verification level. Verification answers the question of the sort: did we build it like we designed it? Or did we do what we intended to? In the case of GPOI it would take the form of: did our activities result in the construction of a training facility or the conduct of a "train the trainer" event as planned? Verification is necessary, especially for any government agency naturally concerned with proper accounting and disbursement of funds. However, verification does not answer the more ultimate "so what?" questions. Hence, the need to evolve the GPOI Assessments to a framework that addresses the validation level question of "did it matter?" To be clear, a "body count" of troops who were trained or deployed, while a good metric to measure for other reasons, is not a validation level question. A validation level assessment would be "how did those trained troops contribute and perform on UN Peacekeeping missions?" or "how has regional security been improved as a result of this expanded capacity?"

This research suggests that the GPOI objectives and outcomes are not fully articulated to the degree necessary to build a coherent assessments framework. The GPOI Implementation Guide (GIG) begins by alluding to what the program intended to accomplish before going into much greater detail into the objectives (Bureau of Political-Military Affairs and Office of Plans, Policy and Analysis 2013). The stated objectives have been, in part, confused with program outcomes and hence been made the focus of the assessments framework. The vagueness of outcomes is in part to blame for the lack of emphasis on validation in the current assessments framework.

First defined outcomes should be articulated and then the supporting, or actualizing, objectives shall be expressed. From the preponderance of literature on the subject it would appear that the GPOI, at the highest level, is trying to achieve two fundamental outcomes: enhanced regional security for its partner nations and an increased pool of well-trained peacekeepers that can successful execute international peacekeeping missions. Figure 1 presents these notional outcomes and illustrates how the stated objectives support them.

These stated objectives and outcomes become the basis of measures of performance (MOP) and measures of effectiveness (MOE), respectively. The GPOI does have a mechanism known as the Full Training Capability (FTC) Assessment, which maps directly, and very thoroughly, to the objective of “Assist partner countries to achieve and sustain FTC in peace operations training.” What is needed, of course, are mechanisms to assess the other five objectives as well as the all-important outcomes.

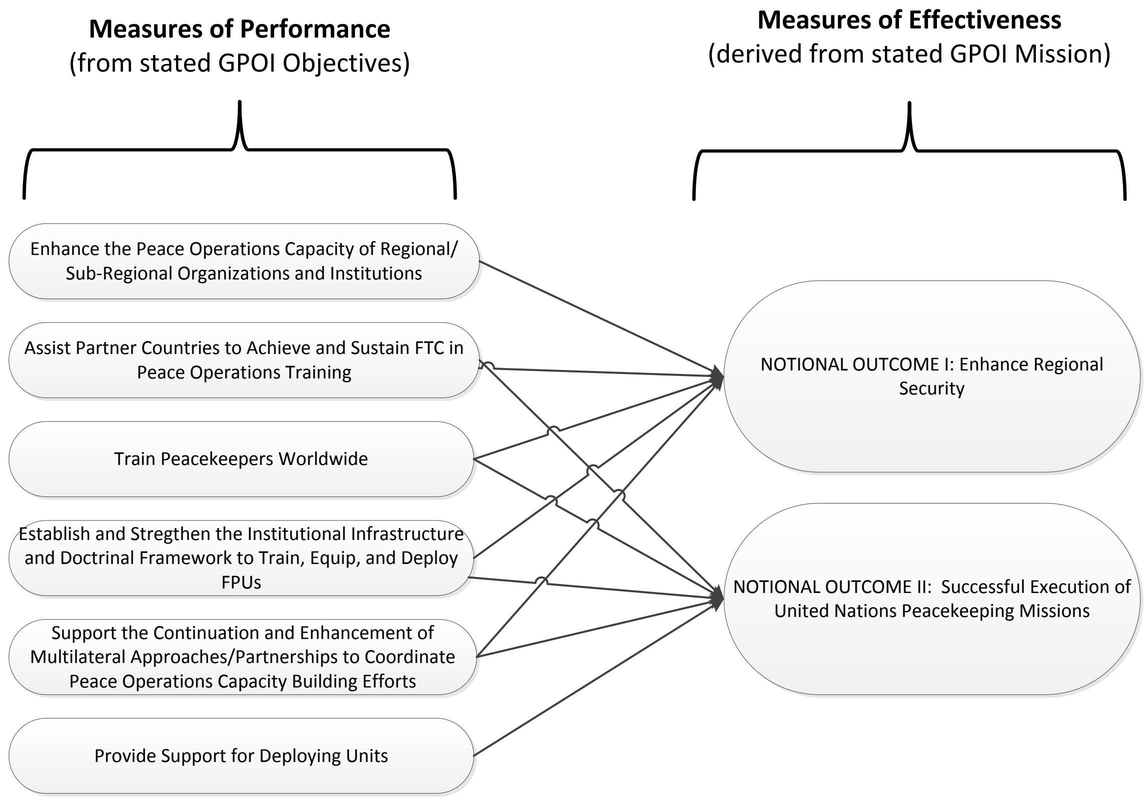

Figure 1. Notional Objectives to Outcome Mapping (after Bureau of Political-Military Affairs and Office of Plans, Policy and Analysis 2013, 2–4)

As mentioned earlier the second family of recommendations can be thought of as a call to embrace a more holistic line of thinking. This research suggests that the GPOI assessments team widen their collective aperture in two ways: the first is to consider the appropriate measurement points in the system and the second is to think about actualizing solutions both as the necessary technical elements as well as the enabling non-technical elements.

Well developed (and traceable) MOPs and MOEs are necessary to assess achievement of objectives and outcomes. However, the stakeholder set is not likely to be satisfied with an understanding of objective and outcomes by themselves; rather the broader question is to understand how system direction impacted system response. As it pertains to GPOI, this would take the form of understanding how the arc of investment (such as money, organizational resources) enables GPOI activities (e.g., building a school house, providing deploying units with equipage) that achieve objectives (e.g., supporting deploying units) that in turn realize outcomes (regional security or successful peacekeeping deployments). Understanding these linkages should help the program manager direct future investment as well as explaining and defending the value of the GPOI to resource sponsors.

Achieving this broader understanding, to include linkages between elements, can be better appreciated by viewing the GPOI system as a process; by thinking of the system as a process, defined measurement points are offered. As shown in Figure 2, this research suggests binning the GPOI process into five categories: plans & policy, inputs, processes, outputs, and outcomes. What is required is a broader assessments framework to manage the spectrum of data, as well as to manage additional assessment mechanisms.

Figure 2. Viewing the GPOI System as a Continuous Process (after Santos 2011)

This is principally a data aggregation issue. Different parts of the GPOI program are likely making useful system measurements, but the information is not necessarily being captured by the assessments framework. For example, the State Department comptroller is no doubt capturing the financial expenditures; however, that data needs to be sent to a central node that is managing the assessment framework.

Hence the second piece of holistic thinking, which is to view the solution space both in terms of the technical and non-technical. The technical element of the solution refers to developing the right assessment models (what this thesis refers to as the data-based architecture). The non-technical element refers largely to significant inter/intra agency coordination (what this thesis refers to as the organizational-based architecture) that is necessary to actualize any assessment framework. The organizational element became prominent in the solution design when it was apparent that additional funds for assessment were likely minimal; hence, this thesis advocates building a cooperative assessments framework to the greatest degree versus building a “better stove pipe” that only one node in the system can execute.

This leads into the third main recommendation, which is to develop a coherent assessment framework from a systems architecting approach. The general approach, as illustrated in Figure 3, is adapted from a business architecture developed by Totem Ltd, a New Zealand-based IT firm (Totem Ltd. 2011). The adapted framework can be understood by breaking it into three levels: structured solution space, structured problem space, and actualizing element space.

The heart of the structured solution space is a capabilities-based architecture that states the problem (as articulated using Systems Engineering methods) in terms of required capabilities. The capabilities-based architecture is then achieved by a functional architecture. Since the solution is naturally information intensive as well as complicated in its implementation, the functional architecture is then bifurcated into a supporting data-based architecture as well as into an organizational architecture. From the data and organizational architectures, the actualizing elements (e.g., assessment models) can then be derived in a traceable manner. Additionally, by developing a coherent framework, other elements, such as organizational components can be worked into the solution space.

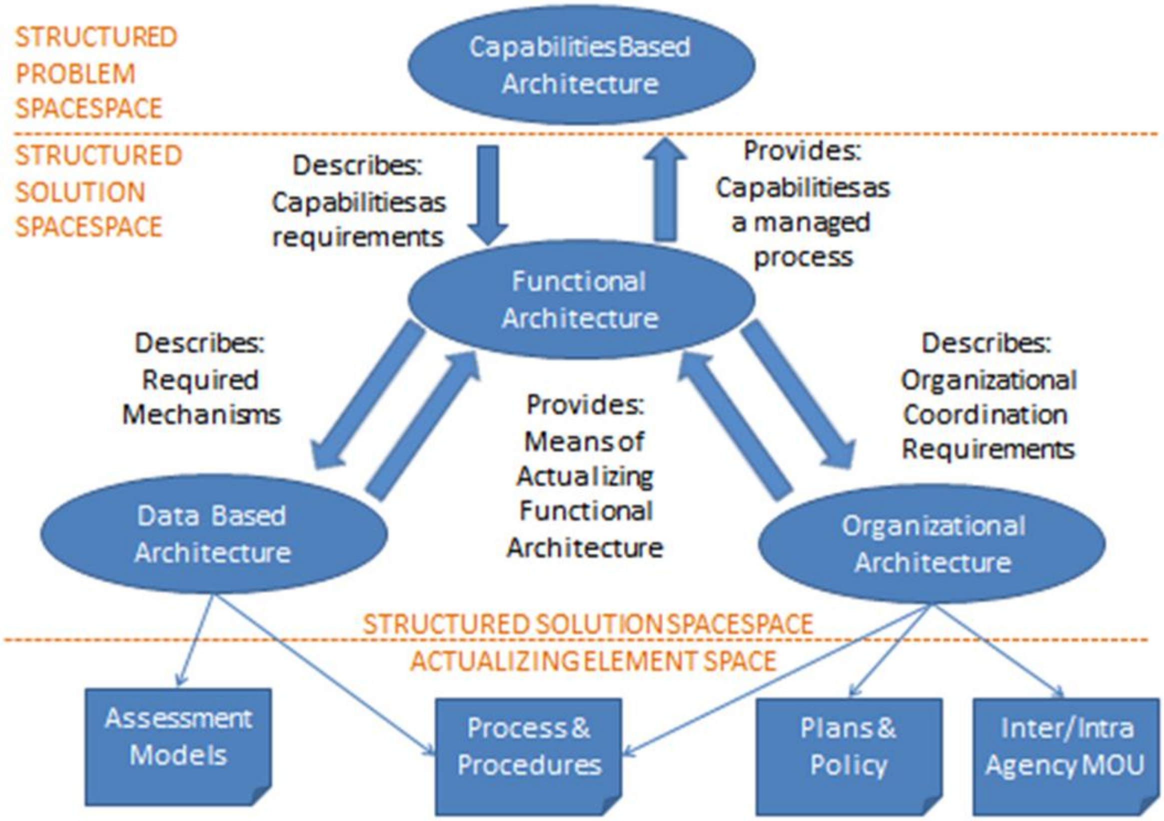

Figure 3. Proposed Assessments Framework (after Totem Ltd. 2011)

Follow on work should focus on two main lines of effort. The first would be to refine and adopt a coherent assessment framework. The second would be to make the selection of specific metrics based on the adopted framework. The difficulty is not in generating metrics, but in picking the right ones. It is achievable using a capabilities management approach as suggested in this research.

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I. INTRODUCTION

A. BACKGROUND

The United States Southern Command (USSOUTHCOM) requested that the Systems Engineering Department at the Naval Postgraduate School conduct research on their assessment methodology for the Global Peace Operations Initiative (GPOI). The GPOI is a U.S. government initiative, implemented jointly by the State Department and Department of Defense that seeks to increase the international peacekeeping capability of partner nations through training events, infrastructure development, equipage, and financial support (Bureau of Political-Military Affairs and Office of Plans, Policy and Analysis 2013). Accurately and consistently measuring the impact of the various GPOI activities has been the principal challenge in the assessment process. The GPOI program managers require a feedback mechanism in order to evaluate past commitments and to help guide future investments. From the standpoint of military operations, the lack of successful assessment makes it difficult for the combatant commands to understand how GPOI efforts impact their particular lines of effort as part of their broader theater campaign plan.

The principal research effort as proposed is to develop a GPOI assessment framework using systems engineering theory with the intent of building an architecture that outputs not just correct information, but the right information. With sound assessment architecture in place, a series of models are then developed in support of the overarching framework. The effort is first grounded in a stakeholder analysis and a mission definition phase to help focus the problem space. A feedback loop with the stakeholder is used to ensure that fundamental assumptions and conclusions as to the desired output are sound. The assessment framework and the associated supporting models are constructed by use of systems engineering concepts such as decomposability, traceability, systems architecting principles, and systems modeling and analysis.

After a first order analysis, it is suggested that the current GPOI assessment could potentially be improved by the application of systems thinking. In systems engineering terms the current framework is a verification tool, in that it seeks to answer the question: "Was the money spent as directed?" While verification is an important and necessary component, it cannot by itself provide the level of insight that is actually required. An assessment framework that is both verification and validation is needed. Validation answers the questions: "Given that a solution was reached (or a course of action taken), was it the right one?" For example, if the GPOI makes a financial investment in a partner nation to build a schoolhouse to train its peace keeping units, a sound assessment framework would address the verification (arc of money from GPOI to a finished school house) as well as the more ultimate validation component (did the school house as built improve unit readiness or the nation's ability to increase capacity in a mission area?).

B. RESEARCH QUESTIONS

1. Primary Research Question

The primary research question of this thesis is: can the complexity of assessing the Global Peace Operations Initiative be understood and managed? Another way of stating this question is: can structure be lent to an otherwise ill-defined problem space?

2. Secondary Research Question

The secondary research question of this thesis is: Given a structured problem space, how should the supporting assessment models be built? The crux of this question is what specifically should be measured from the system and why. There are in existence both explicit and implicit measurement models that pertain to GPOI, but which of them are valid?

C. OBJECTIVES

In support of the research questions a series of objectives are stated. These objectives represent how the potential answers to the research questions would likely be actualized.

1. Expressing the GPOI as a System

The first step is to clearly articulate the problem and lay out the requirements for an assessment system that will meet the stakeholder needs. The emphasis here is on the problem space, the focus should be on determining what the system needs to achieve and not on how the system is to achieve it. Classical SE (Systems Engineering) methods such as stakeholder and functional analysis will be employed. This objective is addressed in Chapter III.

2. Developing a GPOI Assessments Framework

In this effort, the principles of systems architecting are employed with the intention of helping the sponsor manage the complexity represented in GPOI assessments by offering an overarching framework. For the purposes of this research, the framework refers to the overall assessment architecture that connects all of the various functions and operational activities necessary to pull the required information from the system. The assessment framework is a much broader view that looks beyond just describing what should be measured (e.g., a specific assessment model) as it takes into account broader concerns such as who is measuring, were the measurements are taken, and how the measurements are extracted. By starting with an architecting approach, it is hoped that the subsequent assessment models that are offered will be able to operate properly within the broader organizational construct from which they will be employed. This objective is addressed in Chapter IV.

3. Developing Supporting Assessment Models

In order to fill out the aforementioned assessment framework a series of supporting assessment models are required. A series of measurement models can be derived using systems engineering theory. In the final analysis it is possible that a mix of existing, modified existing, and new models will be offered as the suggested composition of an assessments framework. This objective is addressed in Chapter V.

4. Recommendations for the GPOI Assessments Program

Based on the findings of the research a series of specific recommendations are made to improve the GPOI assessment methodology. The final check on whether a given recommendation potentially offers value is an evaluation of whether it is likely to aide improved decision making. After all, the end state is not information for information sake, but it is the right information for the right question to aid analysis and to ultimately assist in the making of sound decisions. This objective is addressed in Chapter VI.

D. METHODOLOGY

There are two mutually supportive processes that have contributed to this research: the individual thesis methodology and the overarching project methodology. The methodology of this thesis refers to the set of processes that were employed towards achieving the objectives as previously enumerated. The second methodology is the overall research plan that encompasses multiple researchers working on the same general problem, GPOI assessments, but from different angles and with different focuses.

Other mutually supportive work is either being conducted concurrently or is notionally planned for future assignment. Understanding this thesis's role within the larger context, offers two important advantages. The first benefit is that it is hoped that the intended work of others, either that which is conducted in parallel or follow on efforts, would aid in the proper scoping and focus of this thesis's research to the maximum benefit of the research sponsor. Secondly, the parallel efforts may offer insights along the way, which might further improve the research. For further discussion of the overarching GPOI research project see Appendix A.

The methodology of this thesis is explained by articulating the architecting approach and the product development. For the purposes of this thesis, the architecting approach refers to how the problem is framed while the systems engineering practices refer to the methods that are employed to process information and actualize results that are discussed in greater detail in Chapter II. Since this effort is fundamentally time constrained, it must be executed on a schedule with a focus on product development, hence the necessary programmatic element.

1. Systems Architecting

The end state deliverables of both this thesis and the larger research effort are generally characterized as both systems engineering or modeling and simulation products. However, it is believed that the before focused SE methods are applied, a degree of systems architecting must be undergone first.

By making systems architecting an explicit element in the design process, is to admit that there is a gulf between the user, who is or whose problems are generally non-technical, and the engineer whose is and whose products are generally technical. Maier and Rechtin (2009, xvii) in *The Art of Systems Architecting* succinctly state:

> Architecting embraces the world of the user/sponsor/client, with all the ambiguity and imprecision that may entail. Architecting seeks to communicate across the gap from the user/sponsor/client to the engineer/developer, and architecting is complete (at least in its initial phase) when a system is well-enough defined to engage developers.

It is believed that before specific measurements models are crafted that a broader vision of the GPOI assessment system must be formulated. The architecture in this case would go beyond physical abstractions and would include elements such as organizational behavior and the stakeholders' priorities.

2. Product Development

The principal lines of effort of this thesis are decidedly characterized as applied research and not as basic research. It is of course hoped that the unique application of systems engineering theory to the problem of operational assessments will contribute to a larger body of knowledge that is generalizable beyond the test case of GPOI. Thus the end state is primarily product development and is not theory expansion.

The products contained within are proffered to be of two general families: prescriptive products and descriptive products. Descriptive products describe the system and benefit the user by giving him or her greater understanding to include increased appreciation of assumptions, context, universe of the possible, limiting reagents in a process, and so on. Prescriptive products are those that offer substantive solutions or suggested improvements. While stakeholders, agnostic of the problem, will generally be seeking prescriptive products, the descriptive might be as important, if not more important, as they enable the refinement of requirements. It is axiomatic to state, but of course starting with the right problem in order to find the right solution, is perhaps the most fundamental and practical application of systems engineering theory. Figure 1 represents at a high level the product families developed by this thesis

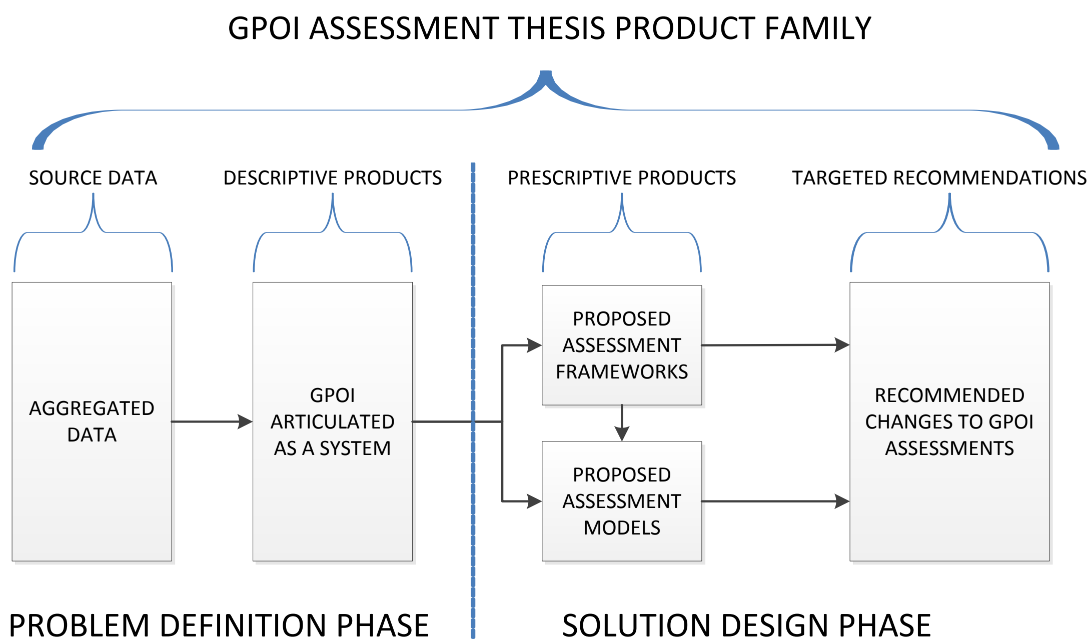

Figure 1. GPOI Assessment Product Family

To achieve the state ends of this thesis three lines of effort are employed throughout: problem understanding, systems architecting, and model development (see Figure 2). As previously mentioned, while problem understanding is the foundational effort, it does not stop at the systems architecting phase. The intent is for the discovery process to continually add understanding to the original problem. Likewise, while the systems architecting is foundational to the model development, the architecting continues throughout as the development of the models will in turn influence and better define the original architecture.

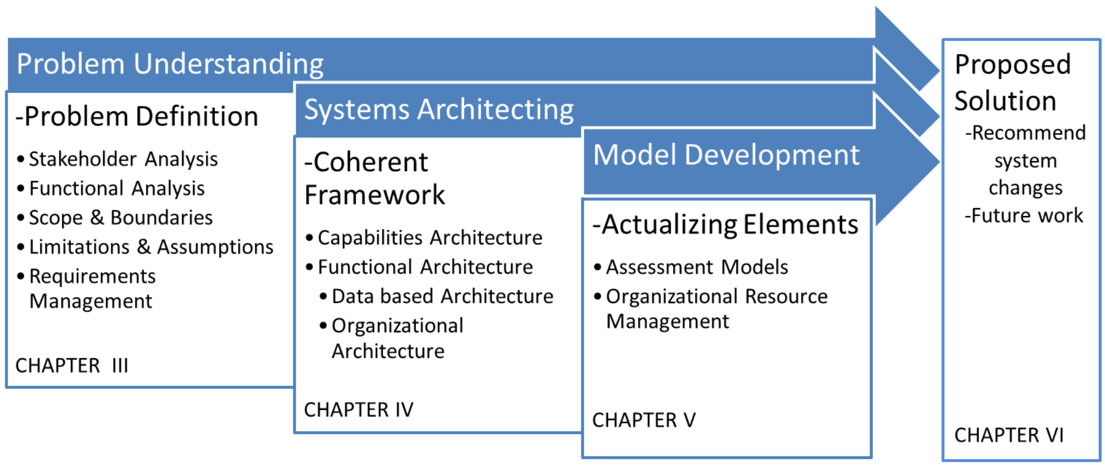

Figure 2. Thesis Product Development

E. INITIAL PROBLEM DEFINITION

As stated earlier, the current GPOI assessment program is verification and not a validation mechanism. While this is still held to be the central deficiency of the current assessment model as it is understood, it is a symptom versus the root cause (Driscoll 2011, 27–32). However, it is proffered that the principal trouble lies in the inherent difficulty in thinking about the problem in a holistic manner. That is, the GPOI program is such a large and complicated system, that in order to properly measure it, the assessors must be able to widen their collective aperture. Of course, when the breadth and depth of analysis is expanded the additional problem of complexity is introduced. Herein lies what is believed to be the root problems facing GPOI assessments: the sheer scale and intricacy of the Global Peace Operations Initiative exceeds the ability of the current assessment process to manage complexity.

There are perhaps other indicators that assessments program requires improvement such as a lack of a codified assessment process and unclearly defined organizational assessment roles. However, these are all symptoms of the lack of system level thinking being directed towards the problem. Thus, if the problem is not approached properly, then the various elements of the solution space (such as the aforementioned process and appropriate organizational dynamics) will not develop satisfactorily.

F. PROPOSED SOLUTION

If the fundamental problem is the mode of thinking, then the solution design starts there. As Patrick Driscoll (2011) stated neatly, “The most powerful way to improve the quality of your results is to improve the way you think” (2011, 28). Thus the first step is to recognize the GPOI for what it is, a highly intricate and ever evolving system and then to embrace the imperative for understanding and managing that complexity if a robust assessment system is ever to be developed and employed successfully.

While the end users likely, and rightly, desire sound assessment models so that they would know what to measure and what the measurements mean, that is the fundamentally wrong level of abstraction to start with. The first step is to architect a framework that accounts for the entirety of the “assessment system.” While the framework includes the assessment models themselves, it must also incorporate other elements such as organizations/agencies, supporting operational activities, and external but influential actors, to name a few. The benefit of the architecting approach is that it will hopefully help determine the pertinent requirements beyond what is required in the assessment models themselves. These other requirements will likely include, but not be limited to, inter/intra-organizational coordination necessities, or codified processes. As these non-physical elements of the architecture will likely drive the success or failure of the system, they are probably as, if not more, important than the assessment models themselves.

While the solution space is broad, any effective resolution must offer both physical design (models) and organizational/behavioral design. The degree of overarching framework that is taken on will influence the models. That is, if the end users support, say a collaborative data collection framework, then each node in the system (such as a nation, agency, or an office) will have fundamentally different models than if actors within the system are acting in a more independent nature.

II. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

The intent of this chapter is twofold. First it is to articulate the elements of systems engineering theory that were applied in the course of the research to arrive at the proposed solutions of this thesis. Secondly, and perhaps more importantly, it is to show that there is value in viewing the GPOI as a system and that systems thinking can effectively be applied to follow on efforts.

A. SYSTEMS ENGINEERING

What follows is a discussion on fundamental systems engineering theory and its applicability in viewing, thinking about, and designing solutions for the GPOI Assessments problem. The intent is not to write an authoritative account on the universe of systems engineering, rather the aim is to highlight the portions that are believed to be directly applicable towards understanding the relevant problem space of the GPOI and developing sound solutions in the area of assessments.

1. Systems Thinking

Making the leap that a given problem set would benefit from systems thinking requires that one assumption be made, one reality be understood, and one imperative be embraced. The assumption is that GPOI can be viewed as a system. An inherent attribute of many systems, to most assuredly include the GPOI, is one of extreme complexity. And finally, the imperative to be embraced, given that the problem is described as a system and very intricate one at that, is that in order to engineer and realize a solution set, the designer must have some capacity to think holistically about the problem space and then an ability to manage said complexity (Driscoll 2011).

a. What Is a System, and Is GPOI a System?

Understanding what a system is and whether or not the Global Peace Operations Initiative can be viewed as one is a necessary, if albeit an unexciting, prerequisite to applying systems engineering theory to the problem space.

In *Decision Making in Systems Engineering and Management* Patrick Driscoll (2011) provides a clear definition of the concept of the system. He describes a system as "an integrated set of elements that accomplish a defined objective" (2011, 33). GPOI fits this definition as it does in fact readily appear to be an integrated set of elements (i.e., partner nations, funding streams, and training activities) that act in concert to accomplish a defined set of objectives (i.e., peace keeping capacity, goodwill, and regional security).

Expounding on the fundamental definition Driscoll (2011) maintains that the "operation of the system lies at the heart of the decision to be made and not the system itself" (2011, 28). This emphasis is most useful for the GPOI problem as it focuses the analysis on what the system does, or should do, and not on the makeup of its constituent elements. This orientation towards purpose and not structure is useful in system architecting, which will be a foundational effort.

b. Systems Taxonomy and the GPOI

Patrick Driscoll's (2011) systems taxonomy of physical, abstract, or unperceivable, was used for its ability to articulate the defining attributes of the GPOI system. A physical system is any system that has observable physical interactions in time and space (such as aircraft or factory machinery). An abstract system is the connection of concepts that may not be observable and but can usually be readily substantiated (management plans or public policy). Finally, there are unperceivable systems whose principal characteristic is their inability to have their constituent elements and associated interactions fully observed and understood. Using the U.S. economy as an example, Driscoll (2011) illustrates the common challenge in dealing with the inherent complexity of an unperceivable system by observing that "despite technology advances and Nobel laureate awardees in economics, error-free future state forecasts of this system remain impossible to attain" (2011, 35).

The GPOI certainly contains subsystems that are physical (training facilities and IT networks), and it certainly has many characteristics of an abstract system (funding approval plans and memorandums of understanding). However, it is best described as an unperceivable system.

c. Implications of Dealing with an Unperceivable System

The importance of accepting the GPOI as an unperceivable system is that it sets realistic expectations. The sheer scale, complexity, and sometimes hidden nature make it impossible to capture all of the constituent elements and their relationships. Thus, any model of the GPOI system will always be an imperfect approximation. An imperfect model will not generate perfect conclusions every time.

This is not to say that the enormity of the challenge should necessitate abandoning the project. While full and complete understanding is unattainable, very useful partial understanding is attainable. Going back to the example of the U.S. economy, while officials working at the Treasury and the Federal Reserve cannot know with one hundred percent certainty the impact of their actions (because they are dealing with an unperceivable system), their understanding of the model, albeit limited, gives them a basis for making rational decisions aimed at specified end states. Thus the mandate for the designer of the GPOI assessments is to build the highest fidelity framework possible that can provide useful insights to decision-makers and then properly caveat its inherent limitations.

In addition to setting expectations properly, recognizing the GPOI as an unperceivable system naturally directs one towards certain approaches. If part of the fundamental problem is complexity then part of the solution (including the solution process) should be simplification. As addressed later, one of the guiding architecting and modeling principles is that of simplification wherever possible.

d. System-Level Solutions vice Symptom-Level Solutions

Systems thinking, as it pertains to engineering design, is first and foremost an orientation towards the system's required objective set (Driscoll 2011). Objectives, in this case, would be defined as what the stakeholder set has determined as what the system needs to achieve. Systems thinking proposes beginning with the end state of the system and then building backwards to include the underlying elements (functions, operational activities, structure, and components) that are needed to achieve the stated objectives. The procedural benefit of focusing on the objectives is that both the requirement development and objective articulation are given the proper priority, thus a measureable arc from fundamental problem to fundamental end state can be drawn.

A temptation in system design or system analysis may be to focus on an element of the problem set that is the most visible; however the risk is that the engineer may have emphasized what is symptomatic and not systemic. While there may be good reasons to address symptoms, not the least would be the potential for "low hanging fruit" that promises immediate value added for a reasonable investment. However, this "problem chasing" paradigm should not be the fundamental methodology applied in system analysis and design. Hence when conducting system analysis the root causes should be sought and when conducting system design the end state should always remain at the fore. The benefit of this line of thought, as summarized by Patrick Driscoll (2011) is that, "This natural focus on output (i.e., results, effects) provided by systems thinking creates a goal-oriented frame of reference that produces long-term, effective *system-level solutions* rather than short-term, *symptom-level solutions* [emphasis added]" (2011, 28).

Systems level thinking can be applied to the problem of developing a sound GPOI assessments architecture. It demands first that the objectives of the GPOI assessments be clearly articulated. Later chapters establish that these objectives are in fact well defined but they have not been made the foundation of the current assessment design. Using the GPOI objectives as stated, the supporting functions and processes can be enumerated, thus creating the supporting architectures from which it is proposed the assessment framework be built (see Chapter IV).

2. Problem Definition

The beginning is the most important part of the work.

Plato, 4th century B.C.

As previously mentioned, defining the problem properly is the foundation of the entire systems engineering process. The end state is to have a solution that addresses the stated problem. This sounds so axiomatic so as to not warrant mentioning, however it quite possible to engineer a "great" solution only to find it does not address the real problem. Hence, proper emphasis is placed on exploring the problem space. As Albert Einstein famously quipped, "If I were given one hour to save the planet, I would spend 59 minutes defining the problem and one minute resolving it" (Spradlin 2012, 84).

a. Problem Definition Processes

This research developed the problem statement using two main families of effort, stakeholder analysis and functional analysis. The end state of stakeholder analysis is to gain an appreciation for what the customer or end-users ultimately require (Buede 2000). Stakeholders are defined here in this thesis as principally those entities that are likely to be directly involved in either the production of GPOI assessments and/or the consumption of GPOI assessments.

The end state of functional analysis is to develop the capabilities that will ultimately need to address the problem (Trainor and Parnell 2011). This thesis used a functional hierarchy to enumerate and organize the required functions of any proposed solution. The key attribute of a functional analysis is that it is fundamentally solution agnostic; that is, it addresses what needs to be done, not how it needs to be done.

b. Problem Articulation

After a foundational research, stakeholder analysis, and functional analysis have been conducted the final step is to articulate the problem. An effective problem articulation includes properly scoping and bounding the problem space. Additionally, any limitations or assumptions should be clearly stated. As previously mentioned, based on the system complexity and lack of observable data in some cases, making well-reasoned, and well-articulated, assumptions are particularly important.

As the research progresses and new understanding is gained, either as a result of the discovery process or interaction with the stakeholders, the problem statement will likely require updating. Trainor and Parnell (2011), in *Decision Making in Systems Engineering and Management* noted, "The initial problem is never the real problem" (2011, 300).

Developing and expressing a problem statement, is considered both a means and an end. It is a means in that it is a necessary prerequisite to develop a rational solution, but it is also an end as descriptive understanding can itself be useful. The development of the problem statement for the assessment of the Global Peace Operations Initiative is detailed in Chapter III.

3. Systems Architecting

A systems architecting approach has been employed to offer a proposed GPOI assessments framework. As already mentioned, parsing the GPOI is a difficult challenge based on the ill-defined nature of the problem as well as the high level of complexity inherent in the system. Architecting, for the purposes of this thesis, is understood as the approach used to conceptualize the structure and behavior of the system. What follows is brief theoretical overview of the systems architecting approached taken in Chapter IV to develop a proposed assessments framework for the Global Peace Operations Initiative.

a. Why the GPOI Assessments Problem Benefits from Systems Architecting

Traditional engineering methods cannot be effectively applied if the problem is not well enough defined. Addressing the ambiguity of the GPOI system and attempt to give it a working structure is essential. Assessment models can be engineered, but not until the requirement space is sufficiently understood. Thus, systems architecting is fundamentally an effort of translation from the context of the user to the more ordered world of the engineer. The sheer size and convolution of the system may indicate, as Maier and Rechtin (2009) point out that "different problem-solving techniques are required at high levels of complexity than at low ones. Purely analytical techniques, powerful for the lower levels, can be overwhelmed at the higher ones" (2009, 6).

b. Architecting Approach

The general approach to handling an intensely complicated problem is to try to simplify it by focusing on the most important elements. Of the several approaches to architecting that can be taken in order to begin conceptualizing the system, Dennis

Buede's (2000) approach has been adopted. According to Buede (2000), there are three fundamental phases that are helpful in fleshing out a working architecture: functional architectural development, physical architectural development, and operational architectural development (Buede 2000).

The functional architecture intent defines what a system must do, usually from a top down orientation. The physical architecture consists of the "resources" or components that are capable of implementing or actualize functions (Buede 2000). By reconciling the physical and functional architectures, an operational architecture is created that acts as the beginning of a system concept.

4. Systems Modeling and Analysis

Throughout this thesis a series of models are used to express the GPOI as a system. The modeling effort is a bit of a translation challenge, as the GPOI, which is not a classical engineering-physics based system, must be represented by systems models that are inherently mathematical abstractions. The importance of development mathematical models cannot be understated. As Blanchard and Fabrycky (2011) aptly point out, "The mathematical model readily indicated the type of data that should be collected to deal with the problem in a quantitative manner," which is of course the desired end state of this research project writ large (2011, 119).

The benefits are worth the work, as sound models go a long ways towards achieving system understanding and lay the groundwork for future analytic efforts that hopefully can suggest substantive system improvements. What follows below is a brief explanation of how modeling is believed to apply to GPOI problem and some guiding principles that were used in development of various models.

a. What Is a Model?

In the most fundamental terms, according to West, Kobza, and Goerger (2011) a model is "an abstract representation of a system" (2011, 99). The more useful definition, as it applies to GPOI assessments, is that a model should be thought of as a representation of a given system that seeks to express the important elements, attributes, and relationships of that same system. George Box famously summarized, "Essentially all models are wrong, but some are useful" (Champkin n.d.). This is to say that no model will mirror every element of the system completely and accurately but can nonetheless be a powerful tool.

b. Why Models Are Needed to Assess the GPOI

While general insight of the GPOI is desired, what is specifically required is an understanding as to what needs to be measured. Modeling helps enumerate and understand these key parameters. The fundamental modeling process calls for identifying the elements and the processes in the system and then defining their relationships. To paraphrase Gary Langford (2013), all interactions between objects and processes can be thought of as falling into one of the four energy, matter, material wealth, and information (EMMI) categories (Langford 2013). With the key objects and processes articulated and the nature of their interactions defined, a mathematically coherent abstraction is generated.

While the fundamental modeling process highlights a list of candidates to measure, it is the follow on analytic effort that helps in correlation and causation determination. Sensitivity analysis can be conducted to help determine the "predictor values," with a sound and validated set of models. This represents the idealized end state of this effort (which would likely require follow on work from this thesis). That is to understand the system so clearly that only a minimum set of parameters requires measurement so as to gain whatever understanding is desired.

c. Key Modeling Principles

There is an abundance of literature on the subject of what makes a good model. However, for the purpose of developing models for GPOI assessments three main attributes (or measures of quality) are emphasized. These three are: (1) simplicity, (2) fidelity and (3) balance (West, Kobza and Goerger 2011).

(1) Simplicity. To the greatest extent possible, simplicity will be sought building GPOI models. Simplicity in models offers both practical and theoretical advantages. The simpler the model, generally the easier it will be for the end-user to

understand and apply (West, Kobza and Goerger 2011). Understanding is necessary for the end user, both to make constructive use of the model as well as to offer improvements to it. Additionally, the simpler the model, generally the fewer and hopefully more reasonable assumptions will be required. A tradeoff can exist between complexity and veracity; that is, simplicity can, but not necessarily, be reduced for increased model precision or accuracy. However, according to the principle of parsimony (Occam's razor), whenever evaluating equally true explanations, the simplest is the best (Heylighen 1997). Hence the models in this thesis were intentionally developed to be as simple as possible. While it is hoped that follow on work will improve the quality of the models, it is believed that any improvements should generally try to maintain, if not reduce, complexity, unless there is a compelling case to be made for the added intricacy.

(2) Fidelity. Fidelity, as a measure of quality, is defined here as how well a given abstraction represents the mirrored system (West, Kobza and Goerger 2011). As discussed earlier it is not practical, and certainly not possible, to achieve a perfect representation, but to the extent possible the modeler should strive for maximum accuracy of his or her model.

(3) Balance. Balance, as a measure of quality, is defined as how well the modeler has handled the natural tension that exists between the aforementioned qualities of simplicity and fidelity (West, Kobza and Goerger 2011). The key for the modeler is to be able to identify and include only the most important parameters in his or her model, thus a good balance between simplicity and fidelity can be achieved.

d. Modeling Methodology

The general modeling processing employed is the methodology as expressed by West, Kobza, and Goerger (2011). For further discussion on modeling process according to West et al., can be found in Appendix B.

e. A Note on Software and Modeling Languages

While the author generally endorses the use of specialized modeling software, such as Vitech's CORE, a conscious decision has been made to render final models using Microsoft Office products wherever possible. This was done for the practical reason of making them more accessible for future edit. Specialized software requires that the end users undergo a learning period before employing the software as well as having to clear the not insignificant barrier of obtaining licenses and permissions prior to use on government networks.

By not employing specialized modeling software dealing with very complex data sets becomes difficult. That is a software package like CORE allows the engineer to handle a large number of elements and their relationships in a flexible manner. However, as the general architecting approach is to simplify and focus on the key elements, this seemed a reasonable trade for generating the models in ubiquitous software that will hopefully make them a little more accessible to both the end users as well as any follow on researchers who would attempt to modify them and roll them into simulation packages.

Modeling languages were selected primarily for convenience of illustrative purposes. FFBD and IDEF0 paradigms were used for their readily understandable nature in hierarchical views and process explanation, respectively.

5. Developing Systems Measures

Chapters IV and V explain that the system measures that should be used are those parameters that are desired end states, traced from the highest level objectives down to the individual tasks. These, by default when developed correctly will in fact meet the requirements for sound measures of effectiveness (MOE) and measures of performance (MOP) as defined by standard SE practices. Of course, as is argued later for the purposes of GPOI assessments it is necessary to also collect measurements on the inputs and the processes. What follows is a brief discussion on the characteristics of valid MOEs and MOP.

a. Measures of Performance

A MOP is principally a question of verification. That is the MOP should seek to answer the question: is the system doing what it is was designed for? In the context of

GPOI, the question would generally take the form of: did the GPOI program execute as it intended to? The answer to this question can be independent of the answer to the question, did what we do matter?

b. Measures of Effectiveness

A MOE is principally a question of validation. That is the MOE should seek to answer the question: is the system accomplishing its stated end-states? Which is another way of asking, has the right solution been developed for the right problem? A system can potentially meet and exceed all MOPs but ultimately fail its MOEs.

c. MOEs and MOPs with Respect to Each Other

To paraphrase West et al. (2011), who offer a way of distinguishing the difference of two measures, MOPs are fundamentally internal-system measures (i.e., did individual components of the system perform to the design specifications) while MOEs are fundamentally context specific measures (i.e., did the system as a whole perform in the intended operational environment?) (2011, 96-98).

Another useful way to look at MOEs and MOPs is to view them in the context of overall system design. As illustrated in the classic SE V-model, MOEs are intentionally placed opposite from the user requirements and the operational concept, whereas the MOPs are placed across from system verification. In the V-model, as shown in Appendix C, the elements on the right hand side are intended to be based on the elements of the left hand side. This is the fundamental concept of traceability, or in other words making sure the right parameter is being measured.

6. Discovery Process

If the requirement set was known at the outset, and believed to be final, then a primarily sequential method would perhaps be the most appropriate approach. However, the discovery of the requirements is in large part the end state itself, which has in part necessitated a more iterative approach to the problem. As Maier and Rechtin (2009, 23) explain, "as the market, or operational environment, reveals new desires, those desires are fed back into the product." For GPOI, the market is represented by the first order stakeholders for whom this research is intended and the operational environment is the GPOI program writ large, which as a complex adaptive system itself, is continually evolving. Thus, even if the problem were to be perfectly understood, which it is most certainly is not, the nature of the problem is continually changing requiring ever evolving and new understanding. To paraphrase Vasant Honavar, a complex adaptive system is one that is characterized by its complexity of its behavior that is it itself the product of its many interactions of constituent elements at different levels of organization (Honavar n.d.).

The iterative process is common in software intensive projects. While few lines of codes are expected to be written in the course of this thesis, the research product line is decidedly “software” and not “hardware.” The products in development are expected to be a framework and a series of supporting models. These models, either at the end of this research, or at the start of the follow on work are expected to be further refined and to be executed inside a simulation package. Iterative approaches, or simply stated a series of refinements based on discovery, is commonly understood by a spiral model such as the one commonly attributed to Barry Boehm (1988).

Figure 3 GPOI Assessment Model Development Process represents the iterative approach that was applied throughout this research based on Boehm’s classic spiral (Boehm 1988). The process started with the stakeholder presenting a needs statement, which was then interpreted into a series of systems engineering artifacts that could be translated into an assessment model. The iterative piece occurs when the designer’s beta, or initial design, is proposed to the user who then offers feedback that results in new understanding by both the stakeholder and the engineer. This refinement process repeats with (hopefully) ever increasing product quality as project resources are expended.

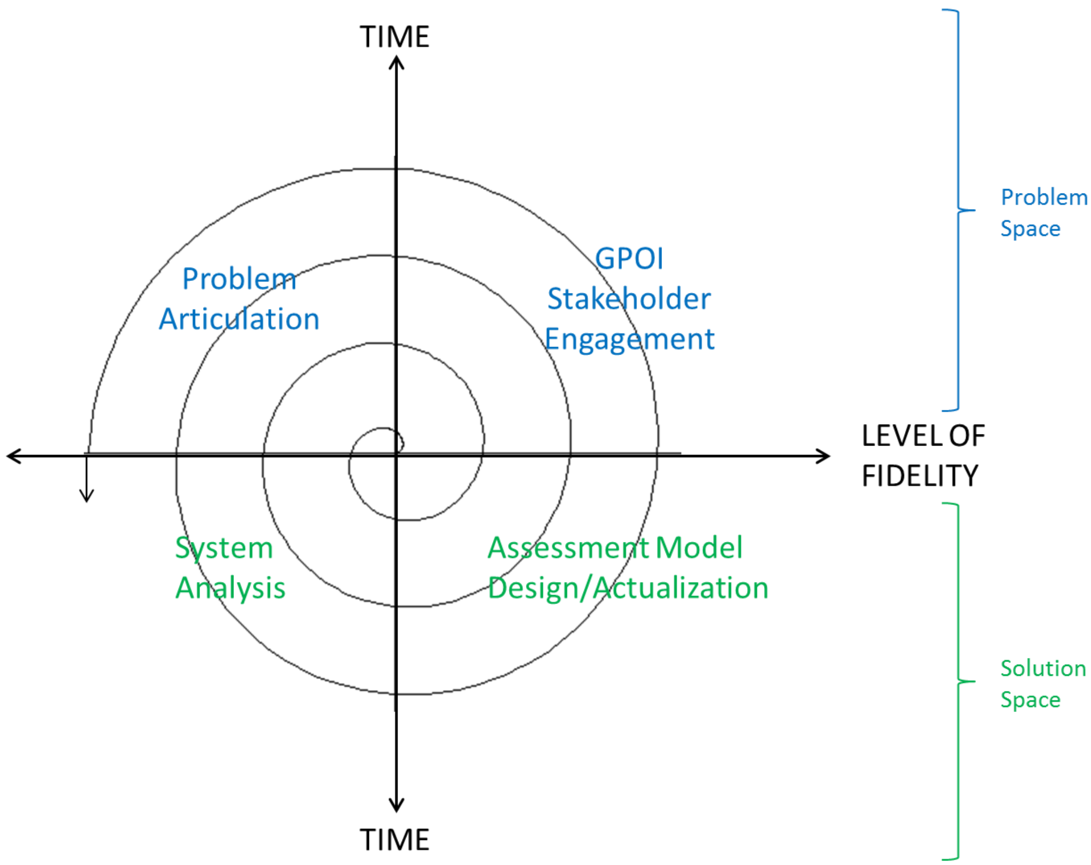

Figure 3. GPOI Assessment Model Development Process (after Boehm 1988)

The spiral process as described will likely be executed whether the designer is conscious of the engineering process or not. A certain degree of trial and error and back and forth with the customer will likely occur, whether or not the designer is consciously operating with the need to think iteratively. There are two primary benefits to making the process explicit. First, there is an inherent value in any construct that helps one organize his or her thinking when addressing a very complex problem. Secondly, and perhaps most importantly, the spiral is a frank admission that at the outset the designer does not understand the requirements so he or she must solicit them from the customer, but the customer does not know them either. Thus the spiral model shows the way out of the circle by starting with a series of designs based on initial understanding and working with the customer to develop an ever increasing understanding of the problem.

7. A Note on Solution Adoption and the Design Process

Richard Balling (1999) speaks to the need of engaging the customer in an interactive design process in his paper "Design by Shopping: A New Paradigm?" To paraphrase Balling, developing the best design (optimization) only really works when objectives and constraints are well known, which is rarely the case, and certainly not the case in the GPOI assessments problem. Since driving to a solitary optimized point in the solution space is unachievable, it is suggested that a series of "rich designs" be offered from which the customer can evaluate, offer a practical means of fleshing out the true, prioritized requirements (Balling 1999).

While this thesis is limited in both its breadth and its depth, a variety of different views and abstractions of the systems were developed in the hopes that if not all, at least some would resonate with the customer either for adoption or for further study. A down selection process, as Balling postulates, is likely to give the designer and customer better control over the development vice a binary response towards a unitary proposal (Balling 1999).

B. OPERATIONAL ASSESSMENT: DOCTRINE AND LESSONS LEARNED

The primary methodology of this thesis is to decompose and then reconstruct the GPOI assessments using systems engineering theory; however, the intent is not to do so in a vacuum. The difficulty in conducting relevant operational assessments is not a new one, and many people from different arenas have grappled with the problem for many years. The intent of reviewing operational assessment literature is to a gain an appreciation for how real-world practitioners have approached the problem, albeit not necessarily from a systems engineering framework.

1. Previous Application of Systems Engineering to Operational Assessments

At the 79th Military Operational Research Society (MORS) Symposium Christopher Santos (2011), a Navy commander and then staff officer at USAFRICOM, presented a very cogent application of a systems approach to assessments (Santos 2011). To paraphrase this author's overarching takeaway from the presentation, the system is for the user and not the other way around. Thus the assessment framework must be designed in a way that works for the user, with available mechanisms and resources, and it must be relevant to application environment. Additionally, the presentation offered several practical insights as to how to marry real world operational assessments and basic systems theory. What follow are some of the key concepts from Santos's presentation that bear mentioning, as understood and interpreted by the author (Santos 2011).

a. The Importance of Plans in Assessment

Santos (2011) makes the point that a given operational or strategic plan is itself a very important part of the assessment process. If the plan itself is sound and built in accordance with doctrine, then the necessary linkages will be clearly articulated. In this context, linkage refers to how the plan describes the intended arc of the policy to action to intended effect and finally to intended outcome. In SE terms, this is process traceability. The implications of this notion is that the plan itself must be assessed, both to mine the necessary measurements that should be used as the activity unfolds (e.g., activities, MOEs, MOPs) and if need be to provide feedback when a plan is lacking in its articulation of assessments (Santos 2011).

b. Viewing a System as a Process and Selecting Measurement Points

Santos (2011) proposed modeling a plan, or series of activities, as a process (see Figure 4). The general idea is that every activity will include some input, a process, an intended output and an intended outcome. The benefit of this strategy is it enables the assessor to manage the complexity of analyzing a large activity, or series of activities, that occur as part of a very complicated system. Additionally, this process view emphasizes the key linkages (i.e., traceability) that are so important to determine the right measures to analyze (Santos 2011).

For the purposes of this thesis an output is the immediate result or objective of a GPOI activity. Examples of GPOI outputs would be number personnel trained in a "train the trainer event" or the amount and type equipage given to deploying peace keeping units. Outputs are measured by MOPs and are generally quantitative in nature. Outcomes are the end states or the "so what" of the program. An example of a GPOI outcome would be enhanced regional security. In comparison to outputs, outcomes are generally broader and can take on a more qualitative nature. The outcomes in this thesis are assessed by MOEs. A proposed list of outputs and outcomes are discussed in Chapter V.

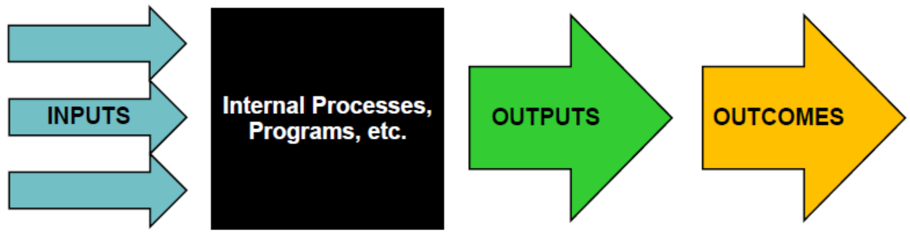

Figure 4. Model Used to Describe a Given System to Be Modeled (from Santos 2011)

c. *The Need for Data Variety*

One of the benefits of viewing an operational activity as a process, as in Figure 4, is that clear and defined measurement points are presented. If the assessment framework takes measurements at each step of the way, a more complete picture can be built.

Santos (2011) emphasized this to ensure the necessary data is on hand to address the analytic requirements, which is of course the reason for data collection in the first place. Specifically, Santos points out that to answer a given question usually requires multiple data types. For example to understand the impact of a given GPOI investment on an allied nation's peacekeeping capability, it is likely that at least three classes of data are needed: measure of input (MOI) (e.g., seed money), MOP (e.g., training facility built), and MOE (e.g., strategic outcome) (Santos 2011).

2. Lessons from Recent Operational Assessments

The intent of this is to build an assessments framework from SE theory, which has its intrinsic value as defined methodology as well as offering a new approach to an old problem. The proposed framework and associated models should be tempered by "best practices" from the field of operational assessments. These lessons learned or best practices offer the designer a set of heuristics. The following is a brief discussion on what are believed to be some of the more salient observations from recent struggles in the field of operational assessments.

a. Importance of Process and Procedure

In his 2010 paper from the Naval War College, "Effective Operational Assessment A Return to the Basics," Robert Michael (2010) lays out an illuminating critique on the universe of doctrine, process, and procedures that apply to operational assessment. As Michael (2010) describes, a recurring shortfall in codified assessment frameworks is a lack of emphasis on process and procedures. Michael (2010) maintains that most publications on the subject focus on what needs to be done, with little mention for who should do it or how. The point is taken, for the GPOI investigation, in that it is likely not sufficient to enumerate the various assessment activities that are necessary to achieve a coherent picture. Due regard must be given to the entities (people and organizations) that enact the models. With the assessor in mind both the assessment models themselves as well as the codified processes and procedures are necessary. (Michael 2010)

b. Data Selectivity

Michael (2010) observes that assessors face the "the tendency to measure what can be measured vice what should be measured" (2010, 5). It appears that GPOI is perhaps not immune from this tendency as there have reportedly been attempts to use readily available troop tallies, known as "body counts," to assess the effect of the program. It is argued that "body counts" are perhaps a legitimate MOP as they likely speak to the capacity of training institutions, but they do not alone answer end state questions as to how the program has made a difference.

c. The Enduring Need for Simplicity

Michael (2010) also observes, "overly detailed assessment and collection mires the staff in the creation of reports and briefs to the detriment of performing valuable analysis for their assessment” (2010, 18) It is useful for the designer of the assessment to keep the end-user in mind; especially the demands that any proposed assessment would put on already scarce organizational resources.

III. GLOBAL PEACE OPERATIONS INITIATIVE AS A SYSTEM

If you don't understand the existing system, you can't be sure you're rearchitecting a better one.

Susan Ruth, 1993

The intent of this chapter is twofold. The first is to provide enough pertinent background information on the Global Peace Operations Initiative so that the reader has a sufficient degree of context to orient herself or himself. The second objective is to articulate the problem space. By adequately expressing the problem, the groundwork will be laid for the solution development. Additionally, a well understood problem is an ends unto itself as it will often produce profitable insights. The models that follow in chapters four and five are very much informed by how the problem is scoped, bounded, and defined herein.

While the GPOI is certainly not a physics- nor a software-based system, which are perhaps the standard subjects of application of SE approaches, the GPOI can be viewed, analyzed, and engineered as a system. Thinking of the GPOI as a system is principally a translation effort; that is raw GPOI data (e.g., GPOI personnel interviews, policy documents) must be rendered into system engineering artifacts (e.g., stakeholder analysis, functional models, problem definition).

A. SYSTEM CONTEXT

What follows is a brief summary of the GPOI with emphasis on its history, guiding objectives, and program management structure. Further background information is readily available to the public, notably from the official Department of State website.

1. Brief History of the GPOI

The GPOI, although a U.S. government managed effort, is conducted as part of a larger international effort to increase worldwide peace keeping capacity. According to official State Department documents, the GPOI represents the United States component of the G8's "Action Plan for Expanding Global Capability for Peace Support Operations" as developed at the 2004 G8 Sea Island Summit (Bureau of Political-Military Affairs and Office of Plans, Policy and Analysis 2013).

The initial mandate was a five-year period (2005–2009) wherein the focus was primarily on creating capacity. The principal end state was to create a large number of trained personnel that could be employed immediately in peacekeeping operations, especially on the African continent where the demand signal was and is particularly high. The seven high-level objectives for the first phase are outlined in Appendix D the most notable of which is the goal of training 75,000 peacekeepers for deployment in Africa. According to the State Department, this goal was exceeded by the end of phase I where by their count nearly 87,000 peacekeepers were trained (U.S Department of State n.d.)

2. GPOI Today—Phase II

Today the GPOI is in its second phase of operation (2010–2014), wherein the focus has moved to supporting partner nations in developing their own organic capability to train and equip peacekeeping forces. The overarching theme of phase II is sustainability (Bureau of Political-Military Affairs and Office of Plans, Policy and Analysis 2013). The intent is for GPOI investments to be made to have lasting impact on a country's ability to train, maintain, and deploy security forces for regional as well as international United Nations security missions. The phase II objectives, as outlined in Table 1, speak to this modified direction.

GPOI PHASE II OBJECTIVES	
1.)	In coordination with other U.S. Government, international community, and national efforts, assist partner countries to establish and strengthen the institutional infrastructure required to achieve and sustain self-sufficient capability to conduct peace operations training;
2.)	Through GPOI-facilitated activities, continue to train peacekeepers worldwide with an emphasis on train-the-trainer instruction;
3.)	In coordination with other U.S. Government and international community efforts, provide support to deploying units to address partner countries' capacity shortfalls;
4.)	Enhance the capacity of regional/sub-regional organizations and institutions to train for, plan, deploy, manage, sustain, and obtain and integrate lessons learned from peace operations;
5.)	Enhance efforts to establish and strengthen the institutional infrastructure and doctrinal framework required to train, equip, and deploy FPUs; and
6.)	Support the continuation and enhancement of multilateral approaches and partnerships to coordinate peace operations capacity building efforts.

Table 1. GPOI Phase II Objectives (after Bureau of Political-Military Affairs and Office of Plans, Policy and Analysis 2013, 2-4)

It is anticipated that by making investments in infrastructure, long-term relationship building, and "train the trainer" events that peace keeping capabilities will become institutionalized in the partner nations, thus providing a source of well trained and equipped security forces for years to come. This most important of end states, which is the first of six phase objectives, is deemed realized when a country has reached full training capability (FTC). The State Department has a defined assessment mechanism for FTC, which will be discussed in later chapters (Bureau of Political-Military Affairs and Office of Plans, Policy and Analysis 2013).

3. Program Management

The GPOI is managed by the State Department's Bureau of Political-Military Affairs and is funded through the peacekeeping operations (PKO) account. In executing high level programmatic functions the State Department works closely both with the Office of the Secretary of Defense (OSD) and the Joint Staff. A series of committees comprised of representatives from both Department of State (DOS) and Department of Defense (DOD) provide regional and strategic direction for the program. As shown in Appendix E, the appropriations for the program are significant at levels approaching $100million a year (United States Department of State n.d.).

At the implementation level, a collection of field offices carry out the funded GPOI activities. According to the State Department, "these implementers primarily include DSCA (Defense Security Cooperation Agency), the COCOMs (Combatant Commands), DOS regional bureaus, U.S. diplomatic posts, and contractors" (Bureau of Political-Military Affairs and Office of Plans, Policy and Analysis 2013).

B. PROBLEM SPACE

What follows is an attempt to decompose the problem in accordance with standard systems engineering principles. The first task is to look at the stakeholder set and attempt to understand their needs in relation to one another. The stakeholder analysis is intended to create a fundamental requirement statement that is derived from the needs of the customers and end users. A functional analysis was then executed to decompose the problem space and better understand what elements will be required in the solution space. Finally, the problem is articulated, but not before the assumptions, limitations, and scope as understood are stated.

1. Stakeholder Analysis

For the purposes of this thesis, a stakeholder is anyone who has an interest in the problem area of assessments in the GPOI and its solution. In the GPOI a stakeholder may take on many different roles such as a consumer of assessments, a producer of assessments, or the subject matter of the assessments (Sage and Armstrong 2000).

The key elements of a stakeholder analysis are to enumerate the stakeholders, try to quantify their objectives and values, weigh their impact on the system, and consider how they relate to one another (Trainor and Parnell 2011). The end state of the analysis would be deduced system requirements as well as potentially identifying problematic issues to be considered during design.

While this thesis is being conducted at the behest of USSOUTHCOM, it is important to consider the viewpoints of as many principal stakeholders as possible. Dennis Buede (2000) spoke to the importance of considering different vantage points when he explained,

> Each stakeholder has a significantly different perspective of the system and the system's requirements. If one perspective is single out as the only appropriate one, the developers of the system will miss key information, and the system will be viewed negatively or as a failure from the other perspectives. (2000, 122)

a. Stakeholder Analysis Methodology

An adapted version of Manchester Metropolitan University's (MMU) stakeholder analysis toolkit was used to organize the stakeholder analysis (2014). MMU's approach frames stakeholder analysis as a component of project management and thus focuses on practical matters that pertain to achieving some defined objective set. Specifically the stakeholders are evaluated in two general ways: the first is by what each entity can contribute to the system and second is the obstacles that are presented by not getting buy in from a given stakeholder. This world view is deemed applicable to the GPOI assessments problem. Stakeholders in the GPOI assessments arena, in addition to their need for information, can largely be defined by their capacity to contribute to the assessment system and how the system is limited based on their participation. Since the GPOI as a system is composed of so many different entities (e.g., DOS, DOD, United Nations, individual sovereign nations) that do not necessarily have to cooperate with another, it is very important to consider how their participation level would impact a coordinated assessment framework. (Manchester Metropolitan University 2014)

b. First Order Stakeholder Analysis

A system as large and complex as the GPOI will possess a correspondingly large set of stakeholders. This analysis focuses primarily on the first order stakeholders. A first order stakeholder is defined as an entity that is directly producing, consuming, or being the subject matter of the assessment. Thus the first order stakeholders for the GPOI assessment were determined to be the implementer set (in this case USSOUTHCOM), DOS, the participating GPOI nations, and the United Nations Department of Peacekeeping Operations (UN DPKO). There are of course several other important stakeholders, but if they could be understood via the first order stakeholder set, they were not explicitly enumerated. For example, a notable admission would perhaps be the United States Congress. While Congress does fund GPOI (no trivial matter), from the vantage point of assessments, they do not directly contribute to the production of assessments, and while they do consume the end product, it is through the intermediary of the State Department.

The summarized stakeholder analysis can be found in Appendix F. Of course, there is a qualitative versus quantitative analysis and any conclusions drawn are inherently subjective to a degree. However, the exercise does contribute to the overall analytic effort by giving a measure of organization to what is a fundamentally ambiguous data set.

c. Stakeholder Analysis Takeaways

After the stakeholders have been catalogued in a rational manner (see Appendix F), the intent is to use that understanding to flesh out the problem space. This particular stakeholder analysis offered some important requirements as well as a few notable system characterizations.

(1) Traceability as a Requirement. All of the consumers require traceability. Whether it is the State Department defending the program or a COCOM trying to determine why an activity should be executed, all must be able to articulate a fundamental linkage of an activity executed to a policy objective achieved.

(2) Outcome Measurement as a Requirement. All of the consumers want the "So what?" question answered. Assuredly, there are other intermediary questions, such as "how did this training event go?" or "how was the money spent on this building project?" However, all of the stakeholders, to varying degrees, desire to know outcomes where impacted (e.g., "how has this line of effort impacted this country's peacekeeping capacity?).

(3) State Department is the Principal Stakeholder. One of the more useful components of MMU's framework is that it encourages the SE to weigh the stakeholder set by their impact and influence on the problem at hand. Impact is defined as how important a stakeholder's participation is to the success of the system. Influence is defined by a stakeholder's ability to move the system in some direction away from the status quo. For example, the implementers' set is defined as high impact (their participation is definitely required) but medium influence as they in large part are subject to overarching policies and processes.

The DOS as a stakeholder is assessed as high impact and high influence. As the administrators of the program of record (POR), the responsibility, and capacity, for maintaining and modifying the strategic vision and policy rests with the State Department. If a different function of the GPOI is analyzed, perhaps the conclusion is different, but as it pertains to assessments the DOS is in fact the principal stakeholder. Certainly the DOD is included and contributes strategic thinking capital, but if a fundamental shift in GPOI assessments is to be accomplished, it is unlikely to happen without the buy in from DOS leadership.

(4) Cooperation and Coordination as a System Limitation. All of the principal stakeholders would like a complete system view; however, none of them on their own have ready access to the information that would enable such understanding. The degree to which data can be aggregated throughout the system will in large part determine the veracity and effectiveness of the assessments. Yes, an individual GPOI implementer can undoubtedly employ a better assessment model, but every implementer will have a finite aperture from which to measure the system. Stated another way, the stakeholder set has a

fundamental decision to make when pursuing an improved assessment framework: either build a better “stove pipe” or pursue a more cooperative approach across agency boundaries. This thesis of course argues for the latter approach.

2. Functional Analysis

Functional analysis, as described by Trainor and Parnell (2011), is “a systematic process to identify the system functions and interfaces required to achieve the system objectives” (2011, 315). And a Function is defined as “a characteristic task, action, or activity that must be performed to achieve a desired outcome” (Trainor and Parnell 2011, 315). If a system’s function and associated interactions are not well understood, it is difficult to develop a cogent requirement set, and without a proper requirement set, it is less likely that the developed solution will answer the stated problem.

While this thesis is narrowly focused on the assessment function of the GPOI system, assessments cannot be studied in isolation because within a system functions fundamentally interact with each other. Thus, the end state of this functional analysis is to decompose the GPOI system only as far as necessary to orient the assessment function within the broader system. By understanding how the assessment function interacts with the other functions the connections can be characterized and defined. These connections (i.e., inputs, outputs) will form the basic requirement set for an assessment function that will behave rationally.

What follows is an overview of how the functional analysis was developed and the understanding that was gained in the process.

a. Functional Hierarchy

Functional analysis is in large part a decomposition exercise. What first must be decided is the top line function to be explored. In this case, the overarching function of “Administer the GPOI” function was chosen. The “Administer the GPOI” function is defined here as the sum total of activities that must be accomplished by the U.S. government, in concert with international partners, to achieve the policy objectives of the initiative. The idea is to choose a level of abstraction high enough to ensure that the function of interest is captured, which in this case is the “assessments function” (Trainor and Parnell 2011).

Once the high level function was chosen, “Administer the GPOI,” all of the supporting functions were then enumerated. The functions are then grouped and ordered logically, which produces a functional hierarchy. Of course, “Assess Progress” was chosen as a first order function intentionally so as to get a view of the system from a specific vantage point. Figure 5 is a graphical illustration of the proposed high level GPOI Functional Hierarchy. A more detailed functional hierarchy is offered in Appendix G.

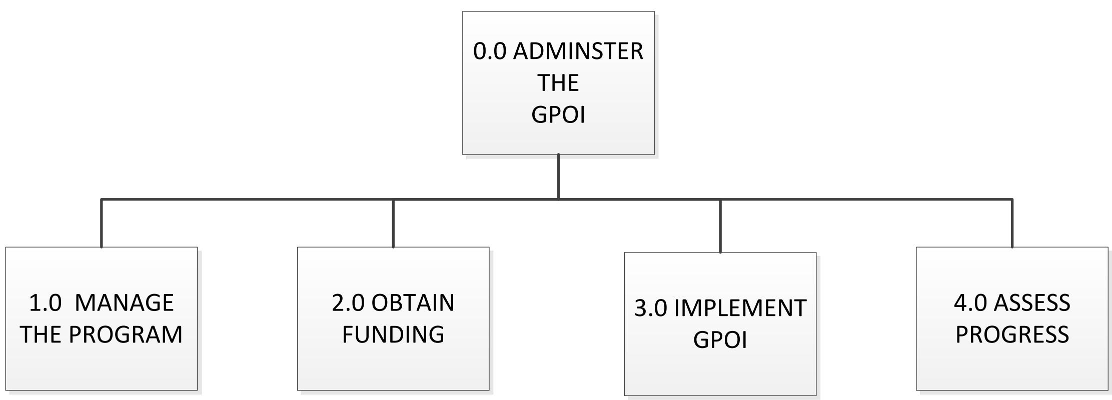

Figure 5. High Level GPOI Functional Hierarchy

The other three first order functions are: “manage the program,” “obtain funding,” and “implement GPOI.” The “manage the program” function is the high level program management function that encompasses activities such as developing processes and procedures and providing oversight. The “obtain funding” function is concerned with all of the activities necessary to request, appropriate, and disperse monies necessary to fund GPOI activities. The “Implement GPOI” function is comprised of all of the activities that are necessary to realize GPOI events.

b. Functional Modeling

The next step is to characterize how the functions interact with each other. As an intermediary step a data flow diagram (DFD) was constructed to help consider the nature of these relationships (see Appendix H). A DFD is a representation of the transmission of data within information-based systems (Buede 2000). The functional model is then more clearly and completely expressed using a formal modeling language. In this case, IDEF0 was chosen for its ability to clearly express interactions of organizational activities as a process. For a brief overview of the chosen modeling language, see Appendix I (Software Engineering Standards Committee of the IEEE Computer Society 1998).

The proposed GPOI functional model (see Figure 6) expresses how the assessment relates to the rest of the system. The nature of the connections was developed from interviews with GPOI personnel and policy as described in the *GPOI Implementation Guide* (GIG) (Bureau of Political-Military Affairs and Office of Plans, Policy and Analysis 2013). In this case, the importance of using codified policy documents to construct the functional model is to express the system “as it is” or “as it should be.” The idea is to remake the assessment for the GPOI and not the other way around. Hence, the rest of the GPOI system (e.g., organizational structure, funding processes, foundational national policies) are by definition design constraints.

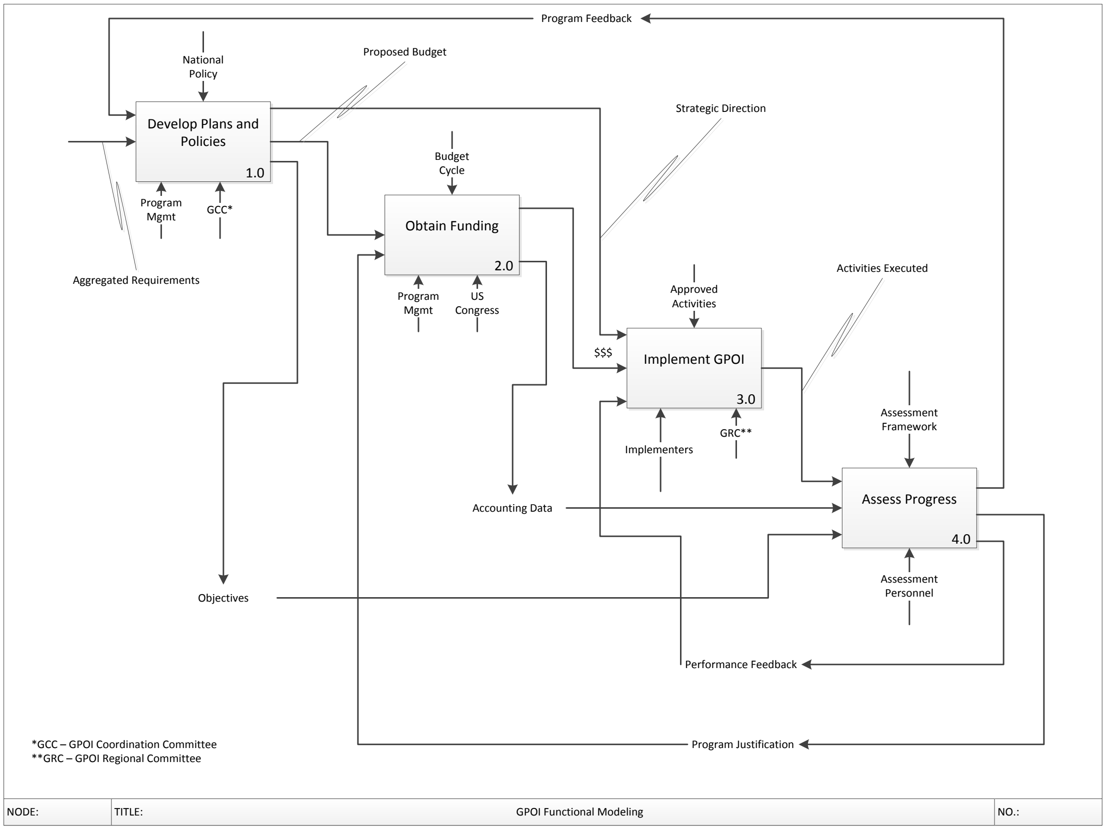

Figure 6. GPOI Functional Model in IDEF0

The IDEF0 model (Figure 6) views the GPOI as a process by expressing the nature of the connections between the various first order functions as previously enumerated (see Figure 5).

c. Application and Key Takeaways from the Functional Analysis

Functional analysis is both an end and a means. It is an end unto itself as it a process model for the GPOI system, that if expressed correctly, properly conveys intra-system interaction. As a means, the functional analysis lays the groundwork for a properly articulated problem statement. See Appendix J for further discussion on the application and salient observations of the functional analysis.

3. Problem Articulation

The stakeholder and functional analysis provided a means of thinking about and organizing an initial requirement set. What is needed next is to properly bound the problem space and apply caveats as understood. Thus, a working problem statement is developed.

a. Assumptions

It is assumed that discretionary budget that can be applied to any proposed improvements of assessments will be minimal. While the case for additional budget towards improved assessments will be made throughout the research, the proposed assessment products must attempt, to the extent possible, to use existing resources or offer some efficiency in exchange.

As a corollary to the understood budgetary constraints, it is assumed that "organizational will" is not a limiting factor. For any assessment product or process to be successfully actualized, it must have the buy in from leadership to the point where it can be institutionalized. While the solution space is viewed as fundamentally limited by material resource application, it will not be viewed as limited by immaterial resource application. Material resources are defined as those that can be readily monetized such as budgets or staff labor hours. Immaterial resources are those means, while not necessarily possessing directly measureable monetary value, are nonetheless valuable and necessary to carry out objectives. An example of an immaterial resource, as it pertains to this discussion, would be inter-agency cooperation or intra-organizational consensus building (e.g., an organization's intrinsic ability to adopt and actualize a product). These immaterial resources are by no means inconsequential; in fact, they may prove to be the greatest impediment to achieving an improved assessment framework. There are assumed to not be limitations because if any suggested product is adopted, limitations will have been effectively obviated. Which is only to say that the research attempts to address organizational issues that impact the assessment, but the burden for ultimately reconciling organizational issues will rest with the program offices and COCOMs in question.

b. Scope

The idea of scoping is to make a intentional decisions as to the boundaries of what the problem encompassess. The intent is to focus the effort and what is central to the stakeholder's need, as well as achievable by the researcher, and exclude all is well. As Maier and Rechtin (2009) put it, "Desirably, scoping limits what needs to be considered and why" (2009, 259).

It is held that the endstate, or the value, of any assessment is its contribution to the decision maker's capacity to make sound course corrections for his or her program or campaign. The decision-makers are the State Department GPOI program managers who are responsible for making sound investments and the COCOM commanders that must incorporate the GPOI within a larger theatre of operations. Thus, the objective of the assessment should be actualized by the arc of observed data to program feedback.

This arc, as it pertains to the GPOI, is represented in Figure 7 as a continuous measurement and feedback cycle. The assessment function can be decomposed into into three sub-functions: data collection function, analysis function, and decision-making function. The data collection function is an umbrella capability that encompasses all the activities that pertain to system measurement and data aggregation. The analysis function is defined by the capacity to make both descriptive and inferential conclusions of a given data set and to generate logical recommendations. Finally, the decision-making function represents the capacity to process analytic products in a larger context and execute decisions (system feedback). While the end state of the work is to ultimately improve the decisionmaking function, it has been determined to focus the prinicipal research effort on the data collection function.

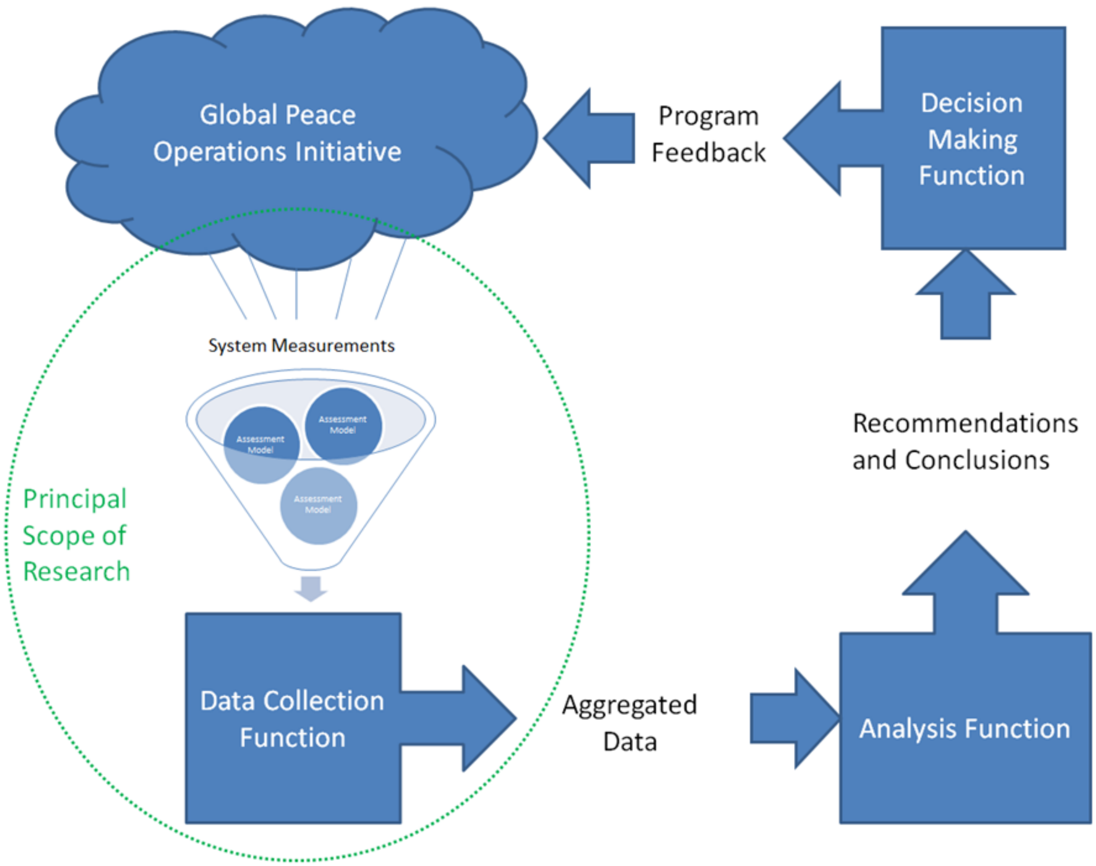

Figure 7. Assessment Cycle

The reasons for focusing on the data collection are twofold. The first is a practical matter of organizational mechanics. That is, the GPOI program, to included elements from both State and Defense, have well developed and codified decision making apparatuses. Additionally, while analytic resources may not be adequately matrixed, the GPOI program offices and COCOMS both possess organic analytic capability in the form of organized staffs. However, the data collection function appears to be the least defined function and likely lacks both resources and a cogent organizational framework.

The second reason for focusing on the data collectionis that it is suspected that the necessary data is not now being collected. The best analysts cannot be reasonably expected to exceed the quality of their available data and the soundness of a program manager's decision perhaps will not exceed the quality of their conclusions. Having an adequate data set is necessary for a functional decision process.

c. Problem Summary

A system is successful when a natural intersection of technology, politics, and economics is found.

A. D. Wheelon 1986

The difficulty in assessing the GPOI can be characterized by two fundamental problem areas. The first is a lack of an intra/inter agency agreement and organizational resource management being directed at the assessment space. The second is the incomplete construction of the assessment models. The first problem is a principally social and the second is principally technical, but they both can be addressed. It is doubtful that addressing one and not the other will offer any substantive gains.

(1) Lack of an Explicit Framework. As alluded to earlier, flawed assessment models are themselves symptomatic of a larger problem. Imagine an individual, he or she could be a contractor, a military foreign officer or an embassy employee, in country with an assessment model in hand. That person may be extraordinarily perceptive and have the perfect set of metrics in hand, but if her analysis is not part of a coordinated effort, then ultimately it may not be of any consequence.

What is lacking is an overarching framework that informs the various components of the GPOI assessment system what they need to measure. What is missing is someone or some organization with a sufficiently broad view to "architect" a system that coordinates the measurement efforts across the enterprise.

This framework needs to be codified if it is to be institutionalized. Additionally, what is missing from the framework is an overall assessments hierarchy. Processes, procedures, and applicable doctrine must also be made explicit. In the USSOUTHCOM process handbook, there are two codified processes for GPOI. One details how a FTC assessment is routed for approval, and the other explains the budget cycle as it pertains to funding individual activities. These two processes are not necessarily faulty, but much more must be mapped out in order to have a robust assessments program (United States Southern Command Process Management and Analysis Cell 2013).

(2) Missing and Limited Measurement Models. As far as this researcher is aware, there is only one assessment model in circulation. This would be the Full Training

Capability (FTC) assessment. The second phase of GPOI has six clearly stated objectives, but it appears that the FTC only maps to the first objective (see Table 1). How are the other five objectives being measured?

The FTC does in fact map back to the first state GPOI objective of phase II. But in determining achievement of that objective, or any of the others for that matter, is enough insight provided to answer the “so what” question? It speaks to how the activities have mapped to a stated program objective, but the broader arc of policy objective to outcome is conspicuously absent.

For example, imagine that objective one (FTC) and objective three (support provided for deploying units) are verified to have been met for a particular country. Does anyone know if it meant anything? That is did those troops deploy and how did they do? Was the mission successful?

The DOS seems to concur in part. The official DOS GPOI website they state, “The program has a substantial metrics and evaluation component which is guided by the following outcome-oriented considerations: actual deployments, effectiveness in PSOs, improvement of capacities, and self-sufficiency” (United States Department of State n.d.). If outcomes are being properly measured as parts of a coordinated assessment process, this researcher is unaware of it.

IV. ARCHITECTING A GPOI ASSESSMENTS FRAMEWORK

The intent of this chapter is threefold. First, the necessities and the uses of coherent systems architecture are outlined. Secondly, a working enterprise level architecture for assessing the GPOI is offered with an accompanying explanation as to how it was developed and how it should be interpreted. And finally, a discussion on how the proposed architecture can be adopted, employed to good effect, and further improved.

A. ARCHITECTURE DEVELOPMENT IN THE GPOI

There are two realities that have made systems architecting necessary to address the challenge of assessing the GPOI. The first is that the problem is so large, so complex, and so ill-defined that it requires a degree of structure to organize its disparate elements. Secondly, this problem presents the need to synthesize across distinct domains; there are perhaps several ways to adequately address the problem. However, any suitable solution would certainly have to incorporate both technical as well as organizational elements. Both the technical and organizational mechanisms will need a degree of coherency if the assessment system is to succeed.

1. Characteristics of a Sound Architecture for the GPOI

This section is both a primer on how to think about architectures as well as a discussion on what are believed to be the important characteristics of operational assessments architectures for application in the Global Peace Operations Initiative.

a. Structure and Completeness

Defining an operational assessments architecture in the Global Peace Operations is a complex problem to understand and therefore a difficult problem to define. What is required is a definitive means of assessing the system, which is inherently technical and complex in nature, through the introduction of a degree of structure via systems architecting. This gives both a starting point for specific design as well as offering traceability back to problem set.

b. Holding the Technical in Balance with the Non-Technical

The various elements of the GPOI assessment system (for both the current and proposed versions) can be binned into two categories: technical and organizational. Technical elements would include the assessment mechanisms themselves (that is a defined set of metrics that organizes system measurement). The organizational elements are those that include the very important agreements, processes, and procedures that enable assessment to take place and synthesized in a meaningful way. Since GPOI assessments requires cooperation from both inter and intra organizational elements, this facet of the problem space takes on added importance.

c. A Way to Think about Architectures

Before presenting the development of the GPOI assessments architecture, a general discussion on how to think about architectures is offered. The intent is for the reader to gain a degree of context as to where architectures can be used in the design process.

One way to think about architectures is a series of viewpoints. Looking at a system from different angles and at different levels of abstraction can help the designer consider the problem in greater totality. Depending on the framework employed, a different part of the system can be understood. In their paper, "Enterprise Architecture Tools for Delivering Combat Capability," authors Steve Carey and Michael Jacobs present three views for a given system: operational view, systems view, and technical view (n.d.). The operational view focuses on characterizing the interaction of the high level tasks (e.g., what people have to accomplish within the system that is important to the operation). The systems view highlights how the constituent systems, or subsystems, interact to achieve a set of capabilities. The technical view brings the architecture down to a set of rules or requirements that inform the actualizing of the various systems and subsystems. These three views are expressed graphically in Figure 8.

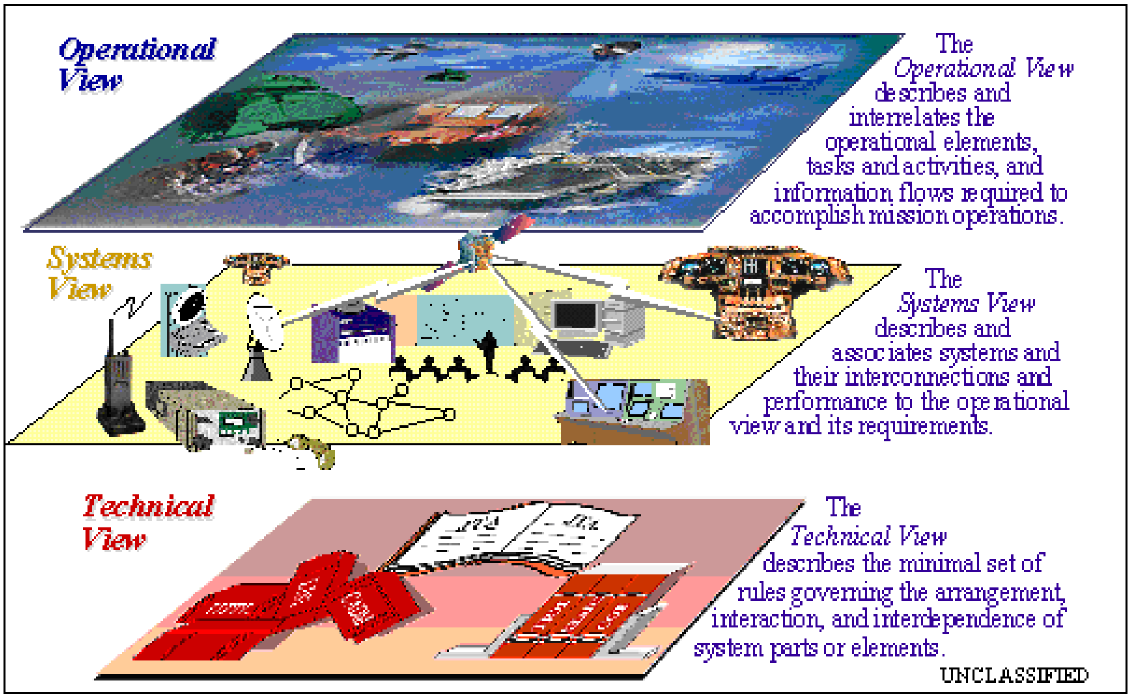

Figure 8. Levels of Architecture Frameworks Explained (from Carey and Jacobs n.d.)

In this thesis, an operational view was used as starting point to begin thinking about the important elements and how they interacted. For development purposes, an operational concept was developed, see Appendix K. The architecture as proposed in this chapter can be characterized as "system views" that focus on articulating interactions of the major systems to achieve suitable assessment of the GPOI. The final step in the architecting process is to drive to the "technical views," which are defined as the required elements to execute the architecture. These actualizing elements in support of the proposed architecture are discussed in Chapter V.

2. Architectural Coherency: Business and Systems Alignment

There is no such thing as a purely technical solution

Brenda Foreman 1990

a. Choosing an Architecting Paradigm

When selecting a framework to give coherency to the proposed architecture, two characteristics were sought: traceable capability management and the ability to balance technical and organizational architectures. The architectural paradigm chosen for application to the GPOI assessments problem was a model developed by Totem Ltd. Totem is a New Zealand IT firm that proposes using a cascading series of architectures to translate desired capabilities into application architectures that will then define the required systems. Totem's architecting paradigm is represented in Figure 9 (Totem Ltd. 2011).

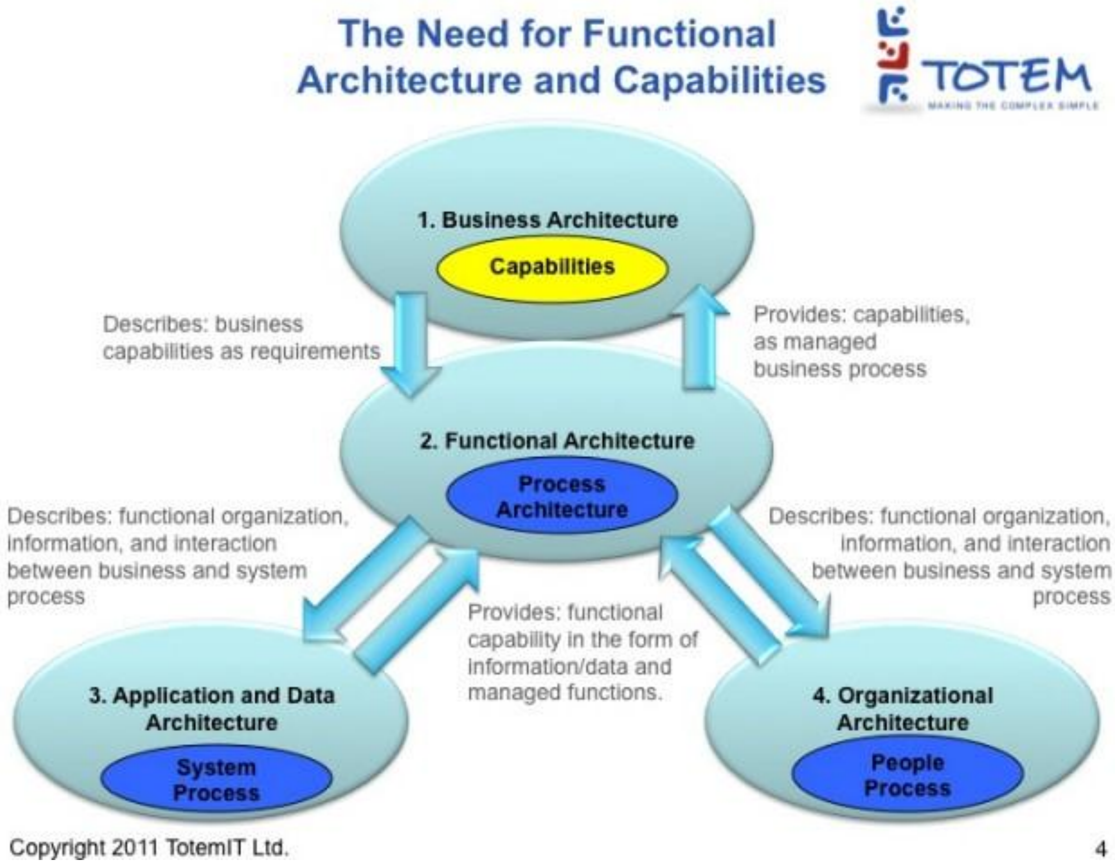

Figure 9. Totem Ltd.'s Model for the Alignment of Business Capability and IT Architecture (from Totem Ltd. 2011)

Totem's architecture is based, in part at least, on capability management as commonly used in the DOD and the United Kingdom's Ministry of Defence (MOD). The idea of capability management, central to the systems design process, is to focus on defining the needs first and then examining the array of means to address them. By focusing on capability, the aperture of design is opened up to other opportunities outside of the pre-conceived solution set. In the DOD world, this spectrum of solutions is commonly referred to as doctrine, organizations, training, materiel, leadership development, personnel, and facilities (DOTMLPF) (Defense Acquisition University 2014). The implication of capability management and the idea of thinking about solution spaces (like DOTMLPF) is that even if the right solution is that material item, there are likely other elements that are necessary to actualize it (e.g., codified doctrine and the personnel component). This application of capability management described above is important not only because it addresses traceability but also includes other elements of the solution space beyond technical mechanisms. Thus, in the proposed GPOI assessments model described in the following section, the top line framework is a capabilities-based architecture.

To realize the aforementioned capabilities architecture, Totem proposes an overarching functional architecture that translates the capabilities enumerated as requirements into specific functions. The idea is not just to enumerate and decompose the necessary functions but to develop their interactions with other functions and system elements until it is made explicit as to what each function needs to achieve (Totem Ltd. 2011).

The functional architecture is then bifurcated into application architecture and an organizational architecture. This emphasis on explicitly addressing the technical and organizational elements as they support the functional architecture was applicable to GPOI for the aforementioned reason of balancing the right technical products with the necessary organizational support (Totem Ltd. 2011).

b. Adapting the Architectural Framework for the GPOI

Totem's original model, as described above and depicted in Figure 9 is adapted and expanded for the application of the GPOI assessment problem. In the proposed architectural framework, seen in Figure 10, three "spaces" were defined: structured problem space, structured solution space, and actualizing element space.

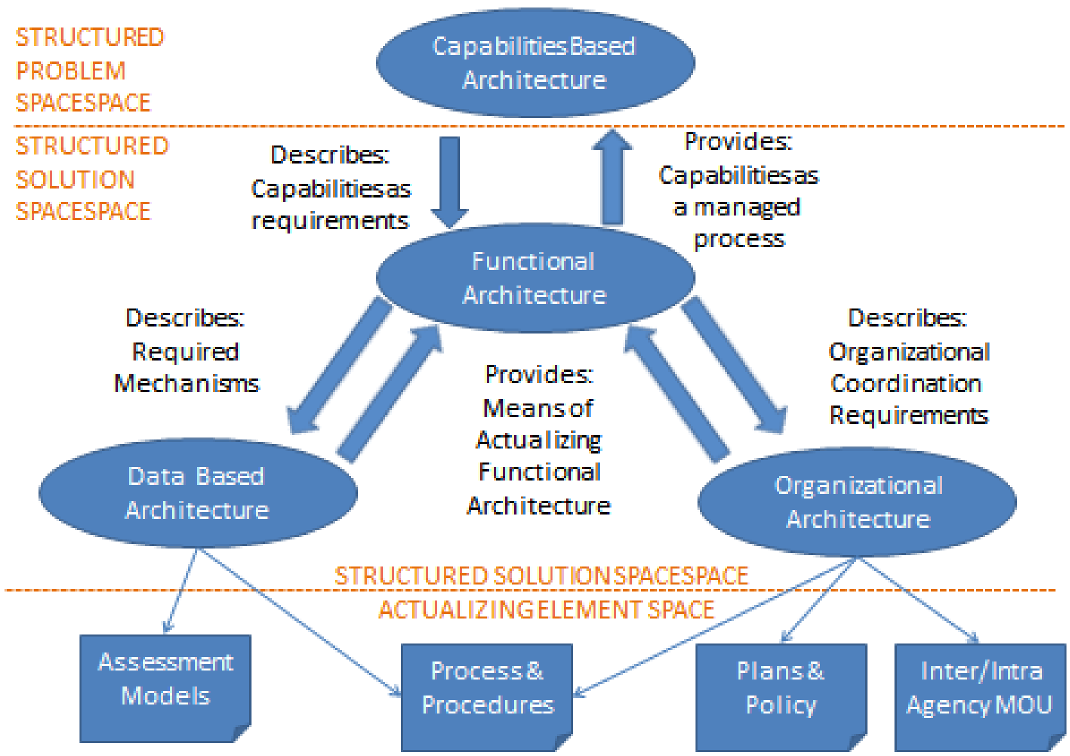

Figure 10. Proposed Assessments Framework (after Totem Ltd. 2011)

The highest level is labeled "structured problem space," which includes the capabilities-based architecture. This capabilities-based architecture describes the systems in terms of what it should be required to do. The capabilities architecture was developed from the problem definition phase of the research (see Chapter III).

The next layer in the framework is the "structured solution pace," which includes the functional architecture, which in turn is decomposed into a data-based architecture and an organizational architecture. This "structured problem space" is primarily a set of systems views that focus on the defining interactions of the necessary constituent systems that would make up a suitable assessments framework.

The third and final layer is the "actualizing element space" which is principally a technical view. Actualizing elements are defined as those components that support the various subsystems in achieving system level capabilities. Moving from the structured solution space to the actualizing element space represents the translation of what is an abstraction of the system to real world products that enable assessments to be executed. The actualizing elements are discussed in greater detail in Chapter V.

3. Capabilities-Based Architecture

The capabilities architecture, describes the system at the level of abstraction in terms of "what it needs to do" to achieve its system objective. What follows is a discussion on the development and interpretation of the capabilities architecture as well as its implications.

a. Proposed Capabilities-Based Architecture

The chosen system objective for assessments in the GPOI is simply "understand the GPOI." This one umbrella objective effectively encompasses the stakeholder set's overall needs. By enumerating the capabilities necessary to "understand the GPOI," a complete and effective assessments architecture can be developed. Figure 11 represents the proposed capabilities architecture for assessing the GPOI.

The overarching capability of "Understand the GPOI" was decomposed into four supporting capabilities: (1) Understand GPOI policy and objectives (2) Understand cost of conducting the GPOI (3) Understand how GPOI is actualized and (4) Understand GPOI's impact. As discussed in the theory section of Chapter II, the intent is to decompose in such a way so as to encompass all of the higher level element as well as reducing, if not eliminating, overlap between elements of the same level. When explaining the four main elements of system understanding, understanding comes from assessment. For the purposes of this thesis, assessment is defined as the formal measurement of a system (or a part of a system) by using a defined metric. Thus, there are two parts of assessments: understanding what needs to measured and why and having the capacity and access to measure.

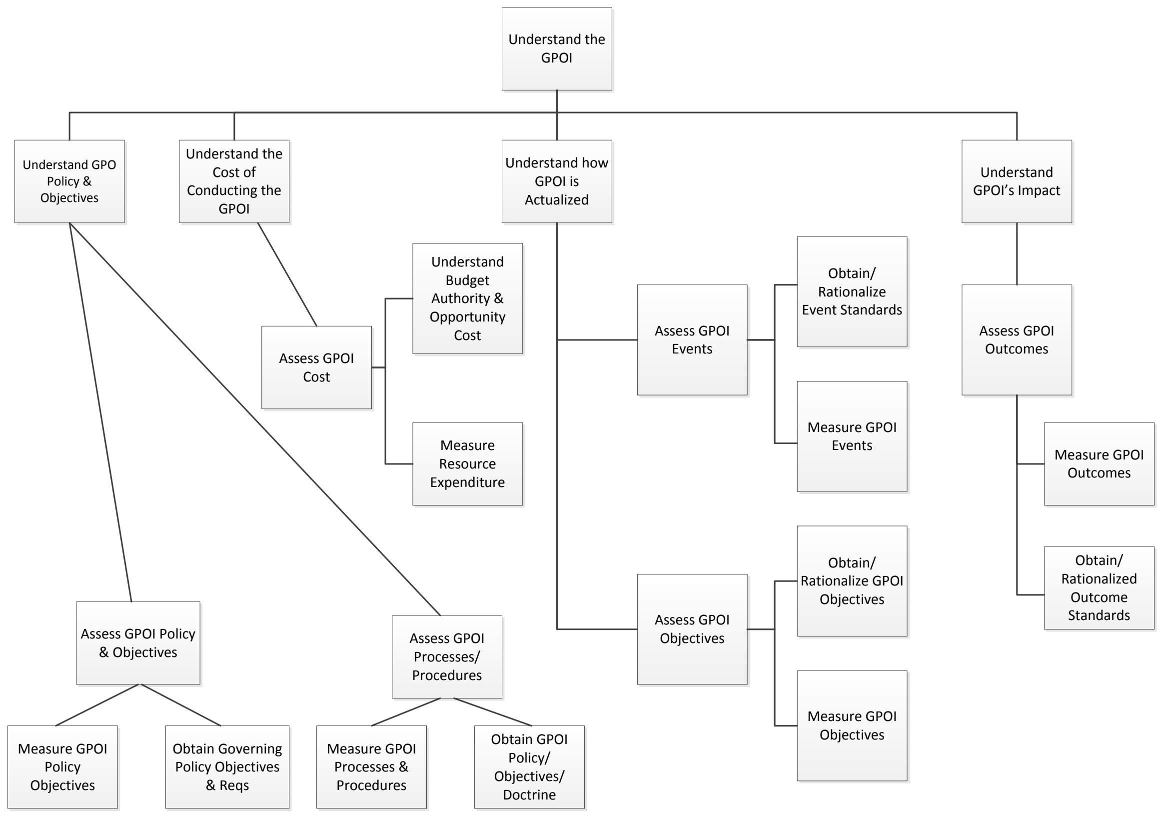

Figure 11. GPOI Capabilities-Based Architecture

As an aside, the capacity to access and to measure a system is certainly not trivial. As historical assessments in the recent conflicts in Iraq and Afghanistan have shown, there is a great temptation for assessors to measure the portions of the system that are easily measured that may not represent the required data set (Michael 2010). There needs to be coherency between the metrics (or assessment models) that are properly developed and measurement mechanisms that contributes to those models.

(1) Understanding GPOI's Policy and Objectives. The capability "Understand GPOI Policy & Objectives" does not directly address assessing the system itself. Rather it acts as a feedback loop to help ensure that the basis and mechanisms of the assessment framework are sound. The capability can be better understood by further decomposing it into the two sub-capabilities of "Assess GPOI Policy & Objectives" and "Assess GPOI Processes and Procedures." This essentially addresses whether the GPOI program

management has formulated the correct objectives and policy goals and whether the assessment activity has formulated the proper processes and procedures in response to the strategic direction.

The assessment framework is expected to be executed at several levels below the policy formation level. However, the staff officers (military, civilian, and contractors) tasked with enacting the assessment framework should be able to look outside their operating level and ask two questions: (1) Are the doctrine, processes, and procedures that are used to conduct the assessments in line with the objectives and policies that have been handed down? (2) Are the objectives and policy (GPOI) consistent with the highest level policy (national) and overarching strategy? As will be shown later in this chapter, this is not trivial as the overarching objectives for the GPOI have not been sufficiently articulated to allow for proper assessment.

(2) Understanding the Cost of Conducting the GPOI. The intent of this capability is to capture the important inputs of the GPOI system. Stakeholders, notably Congress and the State Department, are concerned about the arc of money to real outcomes. Besides the significant financial outlays there are other inputs such as organizational resources (human capital or facilities). This “other” category could either be expressed as opportunity costs or they can themselves be monetized and rolled into the total financial expenditure. The important point to be made here is that while this accounting function is believed to be executed diligently, it must be incorporated into the assessments process at some point. As will be discussed later, one of the goals is to assess correlations and causation of system inputs to system outcomes. As the architecture is developed into assessment models these “costs” are characterized as system inputs and their assessments are referred to as measures of input (MOIs).

(3) Understanding How GPOI is Actualized. This capability speaks to the need to assess how a given GPOI event was executed. This is better understood by furthering decomposing into two sub-capabilities: “Assessing GPOI Events” and “Assessing GPOI Objectives.” These capabilities answer the questions: Were the GPOI events conducted properly? And did the events achieve their intended objective(s)? These are separate questions and therefore separate assessments. It is possible to conduct a

GPOI event in accordance with procedure and policy and not achieve the objective and it is possible, although less likely, to conduct a GPOI event outside of doctrine and still achieve an objective. The first question (processes) gives the GPOI PM insight into how well, and how precisely, the program is being executed. The second question gives the GPOI program manager insight into how the given event is contributing to the stated objectives.

The "Assess GPOI Events" speaks to the procedural compliance of the particular event. Basically, was the event (e.g., build the school, train the trainers, give material aid) done in accordance with statute, process and procedure? This is important both for government accountability measures (expenditure of resources) as well as for application of codified doctrine. If the procedures are insufficient, then the implementers should suggest adoption of "best practices" as they have learned in the field. This capability is manifested later in the assessment models as a measure of processes (MOPr) (Santos 2011).

The "Assess the GPOI Objectives," capability speaks to being able to understand what the GPOI is achieving. These are principally immediate results and not end states. As mentioned in Chapter III the GPOI has a clear set of objectives against which can and should be measured. This capability is manifested later in the assessment models as a measure of performance (MOP).

(4) Understand GPOI's Impact. And finally the "Understand GPOI's Impact" is the capability to assess whether the efforts of the GPOI mattered. The assessment framework should measure the system against a set of "so what?" metrics. This is achieved by making explicit what the desired outcomes or end states of the program are. This is a fundamentally different capability then being able to determine if the GPOI event achieved an objective. For example an event could achieve the stated objective to provide support for deploying units (see Phase II objectives in Table 1) but may or not have contributed to a desired outcome.

b. *Implications of the Capability Architecture*

A capabilities-based architecture offers two principal uses. The first is that it describes capabilities such that a sound functional architecture can be constructed, as developed in the next section. Secondly, it offers a means of critiquing the current assessments framework by highlighting potential gaps in capabilities. Figure 12 is a visual representation of the discussion, which is discussed in more detail in the following sections.

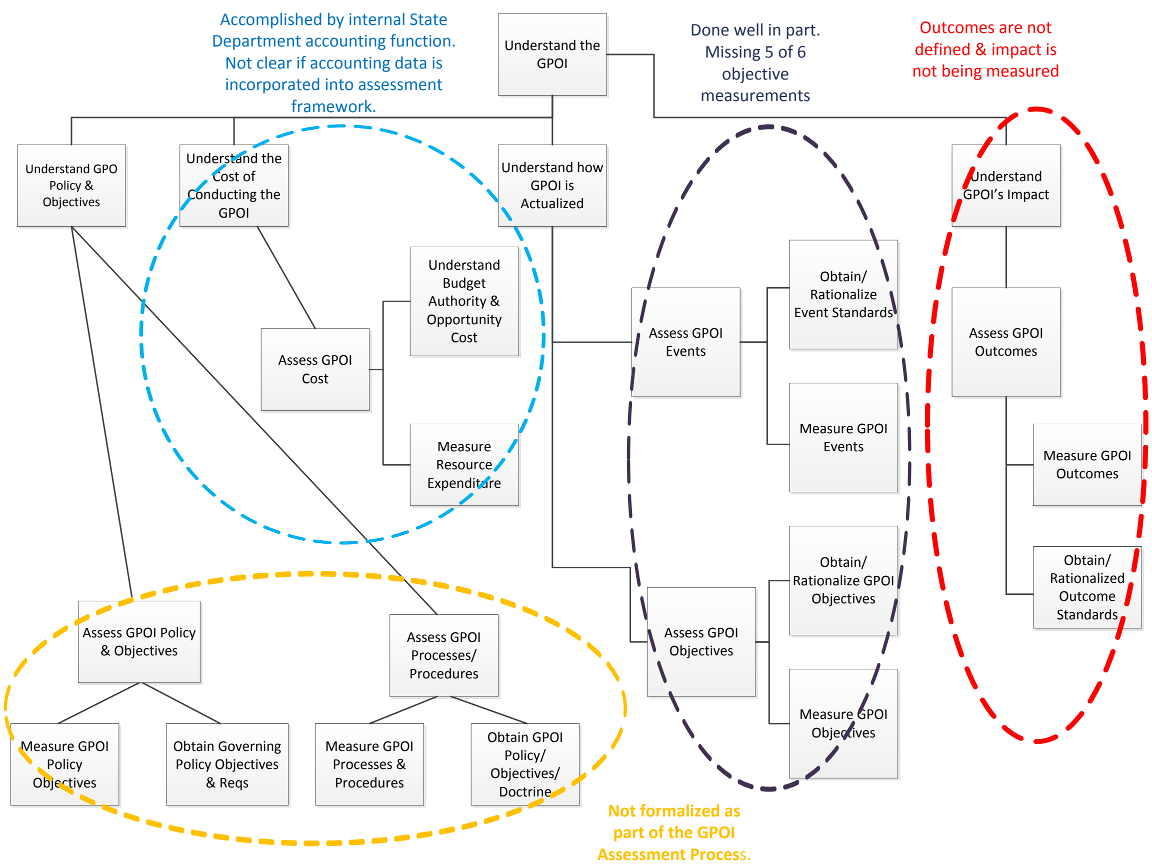

Figure 12. Proposed Capabilities Architecture against Existing GPOI Assessment System

(1) What is Missing from Understanding GPOI's Policy and Objectives? As far as can be discerned this feedback loop is not a current part of the formal assessment process, at least at the implementer level as studied. Elements of program review no doubt occur at different levels throughout the GPOI organization; however, it is a

symptom of not making the feedback mechanism explicit, which makes the assessments framework incomplete. These potential shortcomings are best explained by examining the other three sub-capabilities.

(2) What is Missing from an Understanding the GPOI's Cost? The accounting element of GPOI is likely conducted properly and completely. However, it is not clear if this information, which is likely resident in different databases, is brought into the assessments framework. Speaking for the mathematical coherency of a given model, if inputs are not understood how is the traceability of the arc of policy to outcome explained? Speaking very practically, if cost data is not included in the assessment how do implementers and program executives know which activities are high yield and which are low yield?

(3) What is Missing from an Understanding of How GPOI is Actualized? The author believes that the GPOI is very complete in its approach in laying out approved activities and providing a mechanism for organizational consent. Additionally, the COCOMS (the implementer set being examined) catalogue the execution of these events in their operations database known as Theatre Security Cooperation Management Information System (TSCMIS). What is not clear is how this data inside TSCMIS is migrated to a consolidated GPOI assessment (Perry 2013).

The GPOI has furnished an assessment model, known as the full training capability (FTC) that measures its first objective, which is essentially is "to assist partner nations in reaching FTC." The FTC maps directly back to the first objective. However, the FTC only addresses one of the six stated GPOI objectives. Assuming, these six are the right objectives, a framework that measures seventeen percent of its objectives can hardly be defended as complete. What is needed are models that incorporate the other five objectives.

(4) What is Missing from an Understanding of GPOI's Impact? The principal difficulty with the current GPOI assessments framework is that the outcomes or end state of the GPOI are not made explicit. If the outcomes are not explicit, then how are they to be measured? For example, body counts such as number of troops trained are not outcomes, they are objectives. Measuring number of troops trained is no doubt an

excellent MOP, but it is not a measure of effectiveness (MOE). A corresponding impact for the body count, what this thesis refers to as an outcome as assessed by an MOE, would be something along the lines of: How did troops perform on mission? Or how do those contribute to the peacekeeping capacity of a certain capability level? How did those troops contribute to regional security?

As placeholders to build beta assessment models, the author offers suggested outcomes to be measured based on his understanding of the GPOI based on existing official program documents (see Chapter V). However, this determination should be made by the highest level of the GPOI program management structure with appropriate input and oversight of outside bodies as necessary.

4. Functional Architecture

Functional architecture captures and decomposes all the required functions or activities that are necessary to attain the system requirements. Thus requirements are translated to activities that can then be translated into a physical architecture. While this understanding holds true, a broader definition of functional architecture has been applied herein (Buede 2000).

As the functional decomposition in this framework was very straightforward, additional elements were added to the architecture. The perhaps traditional view of functional architecture was modified to more clearly express the intent of the proposed assessment framework. For this thesis, Totem's view of functional architecture is used, which defines it as a framework that provides capabilities as a managed business process. The emphasis here is on the managed process that encompasses performers (people or organizations) as well as highlighting links to other system elements and the basis of each function (Totem Ltd. 2011).

a. Proposed Functional Architecture

Figure 13 represents the proposed functional architecture for an assessment's framework for the GPOI. The functional architecture as proposed is essentially a functional decomposition placed in context of its application, its applicators, and the elements that should inform and govern the various functions

The functional decomposition is the five assessment functions that describe the various types of assessment that must occur to satisfy the requirements as developed in the capabilities architecture. These five functions are all performed by a series of assessing entities that have been notionally labeled program management, program accounting, implementer planning cell, in-country assessment teams, and outcome assessment activities. These performers are more explicitly developed in the supporting organizational architecture and finally specifically assigned to a real-world person or organization in the actualizing element space.

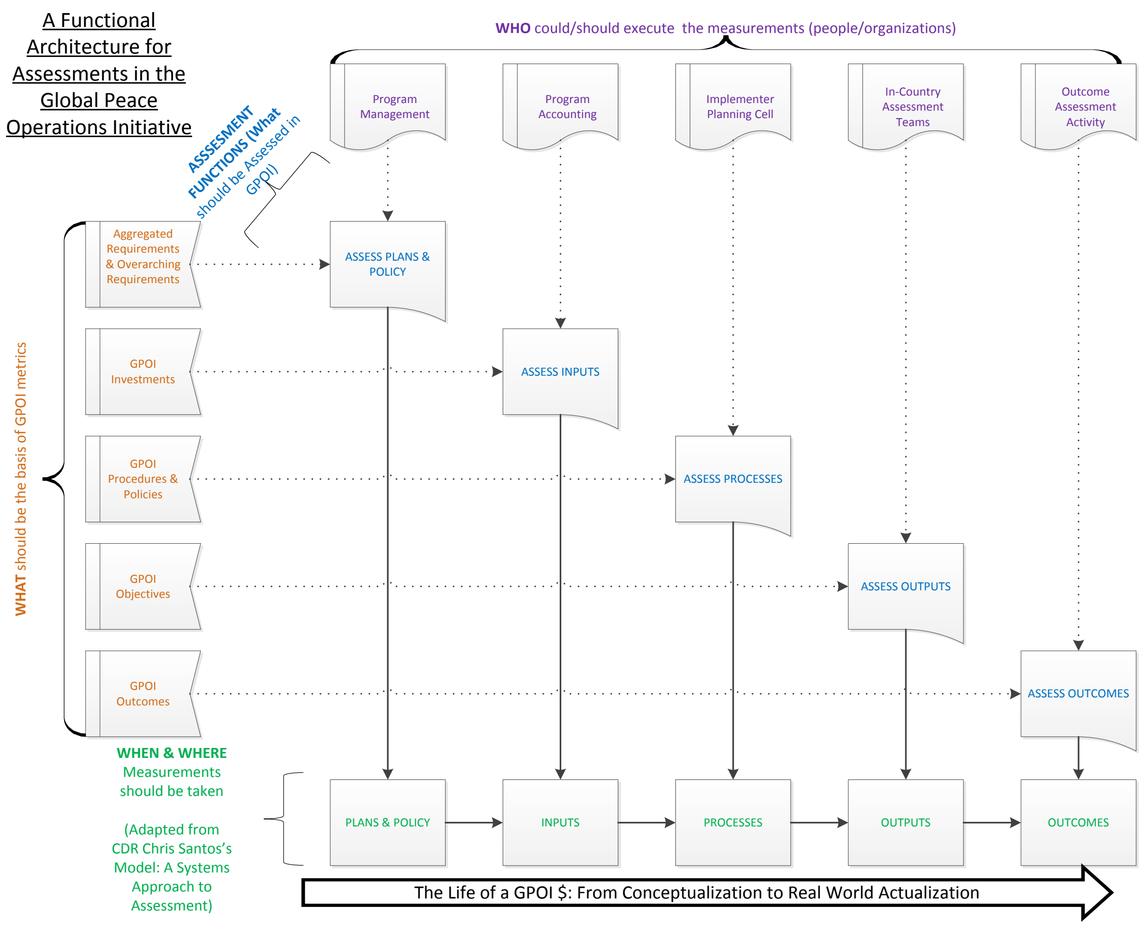

Figure 13. GPOI Functional Architecture

The five assessing functions as enumerated should be informed and governed by logical standards. For example, as shown in Figure 13, the assess output function should be based on the GPOI objectives. What is offered is a one for one mapping that will inform the assessment models themselves.

Additionally, the system functions are oriented to the system itself, as each GPOI function maps to the portion of the system that it should measure. The underlying concept here as adapted from Santos (see discussion in Chapter II on the subject) is that by viewing the system in question as a process traceability is maintained, defined measurement points are offered, and the necessary data diversity is achieved. The key distinction from Santos's model is breaking out plans and policy from the process block as a separate entity for assessment (see Figure 14). As previously mentioned, this was done to specifically assess plans and policy, but also, as explained more fully in Chapter V, because it is not necessary to conduct a plans and policy assessment every time and thus it can be omitted when measuring an individual GPOI event. Additionally, plans and policy, when thought of in terms of precedence, should initiate the process.

Figure 14. Viewing the GPOI System as a Continuous Process (after Santos 2011)

b. Achieving the Functional Architecture

The functional architecture, as expressed in Figure 13, can be summarized as follows: enumerate the high level functions, place them in context of the specific system application points, articulate the governing basis of the functions, and assign an organizational element to achieve them. Hence, the functional architecture is effectively a blend of functions, standards, context, and implementers.

To achieve the functional architecture, one more layer of architecting is required. From the functional architecture view supporting data application and organizational architecture should be developed. The purpose of pulling these two layers out from the functional architecture is to have a basis for developing the end state items that will be required. All of the end state items, also referred to as actualizing elements, can generally be binned as technical products or organizational products.

5. Data-Based Architecture

The intent of the data-based architecture is to enumerate the system requirements that are necessary to achieve the information-based elements of the functional hierarchy (Figure 13) that in turn achieves the capabilities architecture (Figure 12). The data-based architecture describes the framework for properly measuring and assessing the system. As the name would suggest, this architecture is focused on articulating the required flow of data so that the proper assessment models can be built. The assessment models themselves that make up the data architecture are discussed in Chapter V.

a. Proposed Data-Based Architecture

Figure 15 is a representation of the data-based architecture. Four layers, or levels, of data management are proposed. The first is the GPOI itself system from which the assessments are made from defined measurement points. Comprising the second level are the various assessment models that draw upon the system at the aforementioned measurement points. Data synthesis is the third level by aggregating and lending coherency to the various assessment models. And the final level, or the end state of the data-based architecture, is the output of system understanding for consumption by analytic bodies and decision makers.

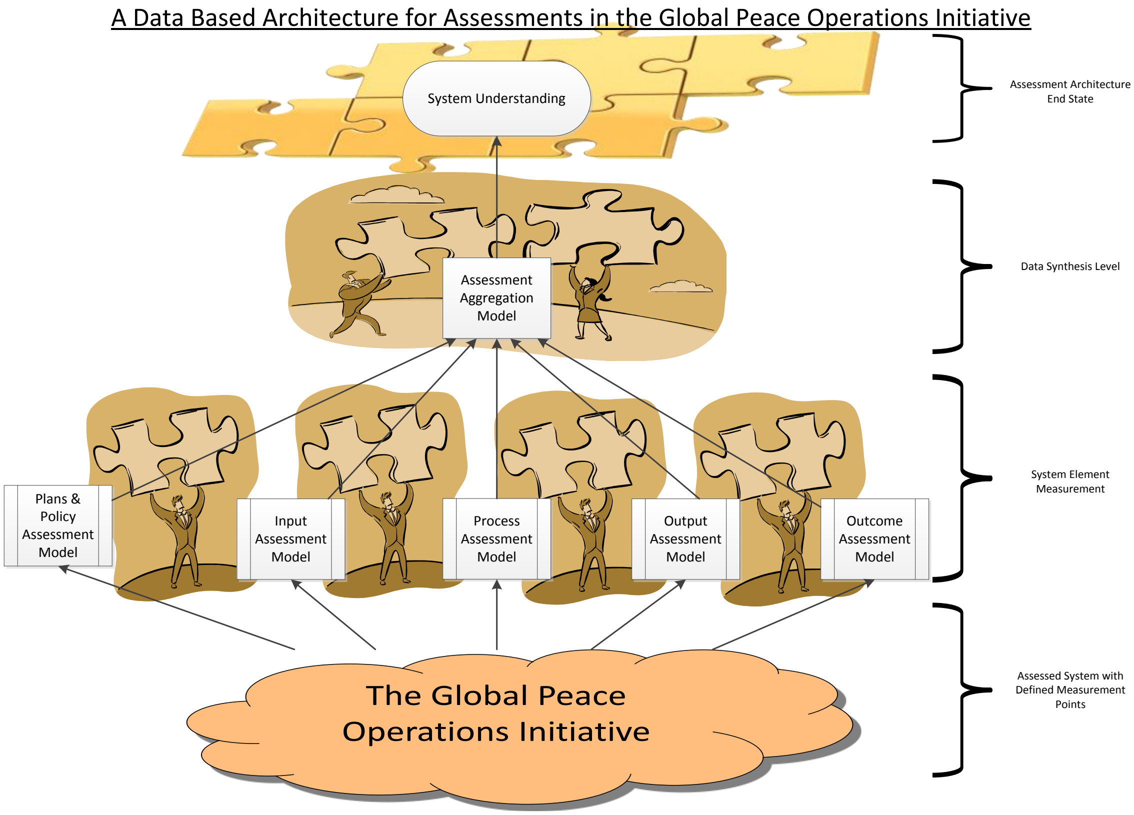

Figure 15. GPOI Data-Based Architecture

b. Implications of the Data-Based Architecture

What follows is discussion on the important takeaways from the data-based architecture. Specifically, this includes the elements of the architecture that define and inform the assessment models that are required to support the framework.

(1) The Necessity and Importance of Assessment Aggregation. It would be convenient if the Global Peace Operations Initiative could be assessed using a unitary model. However, the disparate nature of the data collection activities and storage mechanism used probably preclude this. If the supporting organizational architecture details a division of labor across agency boundaries (e.g., DOD, DOS, DSCA, and UN DPKO) then it is likely that different entities are making assessments at different parts of the system and likely using varied networks and database. The implication is that there is likely the need to draw upon dissimilar assessment resources and synthesize data.

(2) The Need for Data Diversity. As discussed in Chapter II, depending on the question being answered different parts of the system will be need to be measured. Hence, the importance of constructing data architecture that is capable of measuring across the system. Data diversity, which is defined in the proposed assessment models as making measurements in each part of the system (as defined by process flow in Figure 14), also helps maintain traceability.

(3) The Need for Defined Measurement Points. As discussed throughout, mining the right data from the system is the key to making the assessment framework function. It need not be overly complicated to determine the correct measurement points. Measurement points can be determined using two concepts. The first is decomposing the requirements to determine what type of data is required. And the second concept is traceability, which is simply expressed by matching data type to data requirement. For example, when building the output assessment model (which was determined to be required), its various metric should be based on the stated program objectives.

6. Organizational Architecture

The organizational architecture is the non-technical corollary to the data-based architecture. While the data-based architecture describes information flowing through levels of the system using various assessment mechanisms the organizational architecture describes information flowing through the system using various organizational nodes. An organizational node is defined as a person, agency, or entity that carries out an activity in support of a requirement. Again, the importance of expressing both data and organizational views is that for every level of the assessment framework there is required to be some technical mechanism as well as a node to execute it.

a. Proposed Organizational Architecture

The proposed organizational architecture, as expressed in Figure 16, was built using the OV-2 operational node connectivity description as a template. The OV-2 is adapted from a Department of Defense Architecture Framework (DODAF) view that expresses the system in terms of how information moves from various nodes. The two main features of the OV-2 are the nodes themselves, which should enumerate who is doing what activities and need lines that are defined by the type of information that moves across the connections (Dam 2006).

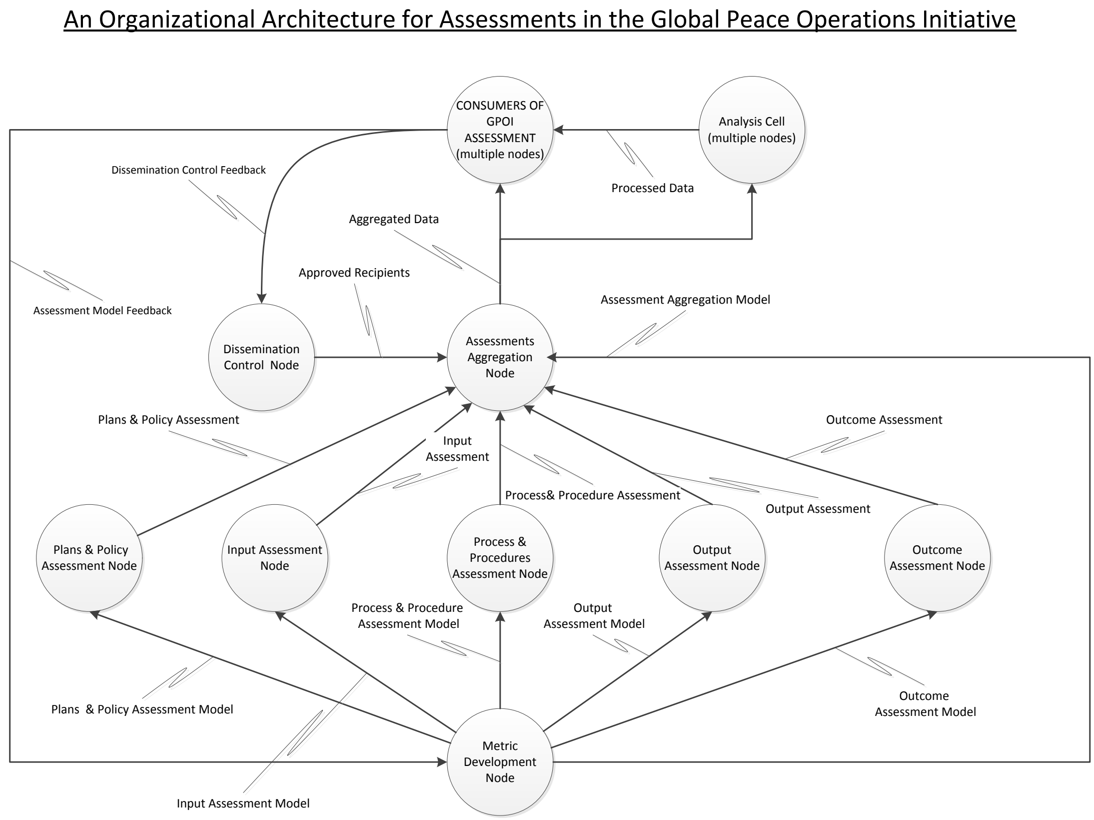

Figure 16. GPOI Organizational Architecture

b. Implications of Organizational Architecture

What follows is discussion on the important takeaways from the organization-based architecture. Specifically discussed are the characteristics of the architecture that define and inform the actualizing elements that will be required to support the assessments framework. In this case, the actualizing elements that would be informed would include, but not be limited to, processes and procedures and organizational resource management.

(1) Organizational Resource Management. The point of enumerating the various nodes is to make sure that all of the necessary assessment activities are explicitly

assigned to the right agency. While it is possible that multiple nodes could be serviced by one organization, it is doubtful given their disparate nature that they could all be serviced effectively by any one entity. Hence, a beta organizational resource management plan is offered in Chapter V to assist the parties in developing the appropriate coordination.

(2) Information Promulgation Concerns. The architecture recognizes that the nature of the information, especially when taken in totality as it aggregates, may in fact be very sensitive. Thus, there likely needs to be a node in the system that controls distribution of assessments. This is to reiterate that assessments are not carried out for their own sake but are part of a larger decision-making process.

(3) Process Development. A benefit of expressing an organizational framework is that it lends itself to building necessary process models. What was proposed in Figure 16 is only a high level abstraction. But if it were to be expanded with its supporting actualizing elements and verified, it would go a long ways towards making explicit the processes necessary to run an effective assessments program.

B. ARCHITECTURE ADVANCEMENT

The architectures as presented in this chapter were based on the need to bridge void that existed between a fuzzy problem space and a defined solution space. Nevertheless, there is likely much room for improving the completeness and accuracy of the proposed architecture.

1. Implementing the Architecture

The mechanisms, or what has been described as the actualizing elements, must be enumerated and developed. The enumeration of these actualizing elements as well as their partial development is offered in Chapter V.

2. Refining the Architecture

Building the actualizing elements as laid out in Chapter V does improve the architecture. However, the architecture should be refined in two ways. The first would be a continued spiral development (see Figure 3) between researchers and end users. And the second is the verification and validation process of testing and employing the framework and its associated products when the sponsor is adequately satisfied with the product.

V. DEVELOPING ACTUALIZING ELEMENTS

The intent of this chapter is to further the proposed assessment framework for the GPOI by developing the next level of abstraction of the design in the actualizing element space (see Figure 10). As previously defined, the actualizing elements are those components of the design that constitute the data-based and organizational architectures. The actualizing elements that are developed in this chapter are principally the assessment models themselves and an organizational resource management plan. There are other necessary actualizing elements, such as codified processes and procedures, which are discussed but not developed to the same level of detail.

A. SATISFYING THE DATA-BASED ARCHITECTURE

The data-based architecture as developed in Chapter IV (see Figure 15) yields requirements for the eventual assessment models. The three most important data-based requirements can be summarized as follows: (1) it necessary to have defined points of system measurement (2) at least five different assessments will be necessary (plans and policy, inputs, processes, outputs, and outcomes) and (3) there is a requirement to aggregate and synthesize these five assessments.

1. Making Outcomes and Their Linkages to Objectives Explicit

As discussed in the development of the capabilities architecture in Chapter IV (see Figures 11 and 12), there is a fundamental need both to state clearly the outcomes as well as to measure them. The mission of GPOI is clearly stated. However, it the mission (or end state) should be expressed as a series of defined outcomes. Additionally, once the outcomes are enumerated, supporting objectives must be clearly linked to outcomes. If an objective does not link to an outcome, then it probably should not be an objective at all (Bureau of Political-Military Affairs and Office of Plans, Policy and Analysis 2013).

a. Outcomes in Context of the System

A sound assessment framework would be able to answer an array of questions, but none is more important than: "Did the GPOI investments matter?" As illustrated in

Figure 17, plans and policy dictate program events (or lines of effort) that should achieve objectives in order to realize the end state outcomes.

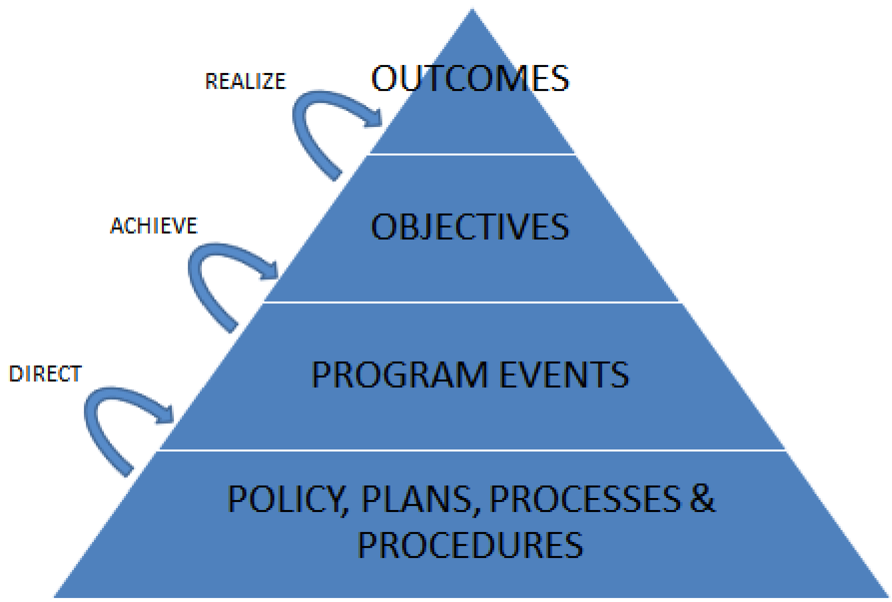

Figure 17. Defined Outcomes in Context of the GPOI Program

This simple and straightforward line of thinking bears an important implication for the design of an assessment framework: both the levels themselves and the linkages between the levels must be defined if the operational planning and follow on assessment are to be coherent.

b. Proposed Outcome Definition for the GPOI

In the *GPOI Implementation Guide* (GIG) the U.S. Department of State lays out six objectives (see Table 1) for the program to achieve during phase II. All six of these objectives are decidedly measures of performances, and they should be explicitly defined as such. While the outcomes or MOEs of the program are not made explicit, the overarching mission is clearly articulated. The GIG states that, "GPOI's phase II mission is to enhance international capacity to effectively conduct UN and Regional peace operations…" Hence, the two formal outcomes for assessment (MOEs) are defined as: (1) Enhanced Regional Security and (2) Successful Execution of United Nations Peacekeeping Mission (Bureau of Political-Military Affairs and Office of Plans, Policy and Analysis 2013).

These two MOEs capture the GPOI mission. The six objectives (MOPs) all map to at least one MOE (see Figure 18).

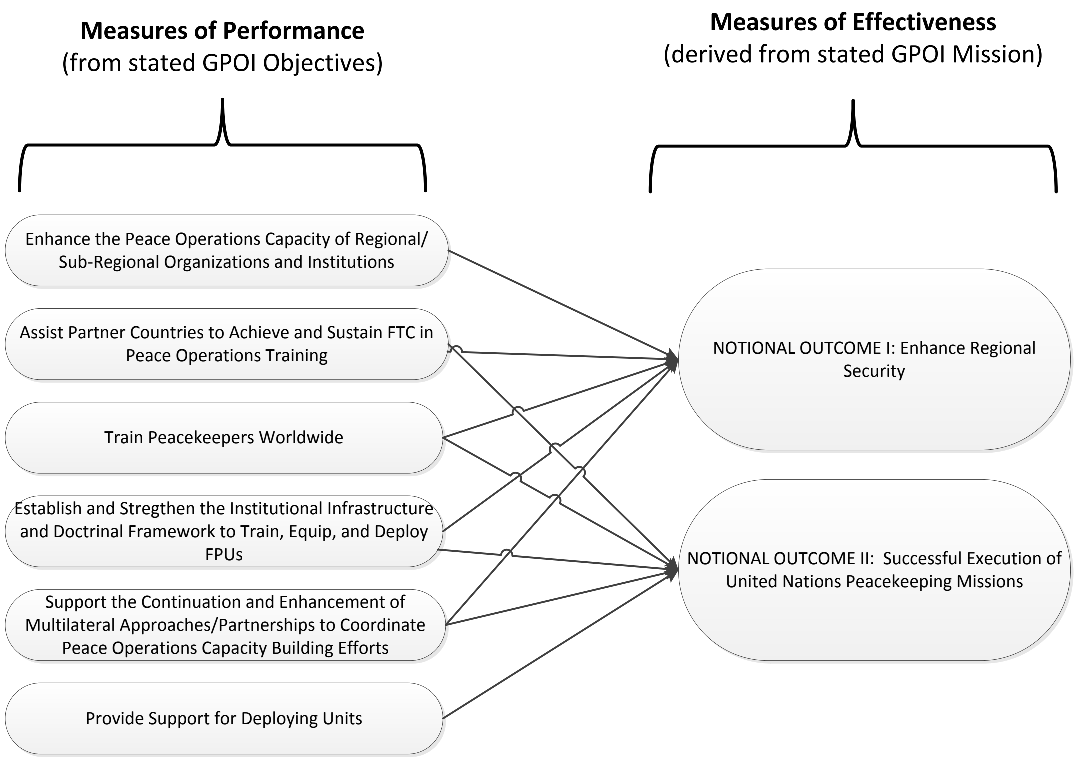

Figure 18. Linking Objectives (MOPs) to Outcomes (MOEs) (after Bureau of Political-Military Affairs and Office of Plans, Policy and Analysis 2013)

c. *Time and Space Distinctions between Objective and Outcome Assessments*

With the objectives and outcomes clearly defined as well as their linkages, the practical matter of their assessment must be considered. In Figure 19, it is suggested that achievement of objectives and realization of outcomes occur at fundamentally different points in the process and thus should be assessed separately.

Objectives are achieved by the GPOI program through a series of approved events. The MOPs should be assessed during or directly following a GPOI event. Indeed, every GPOI event should have built into the plan a means of assessing the degree to which the objectives were achieved. The implementers themselves or other elements of the in-country political-military group would be good candidates for carrying out these assessments.

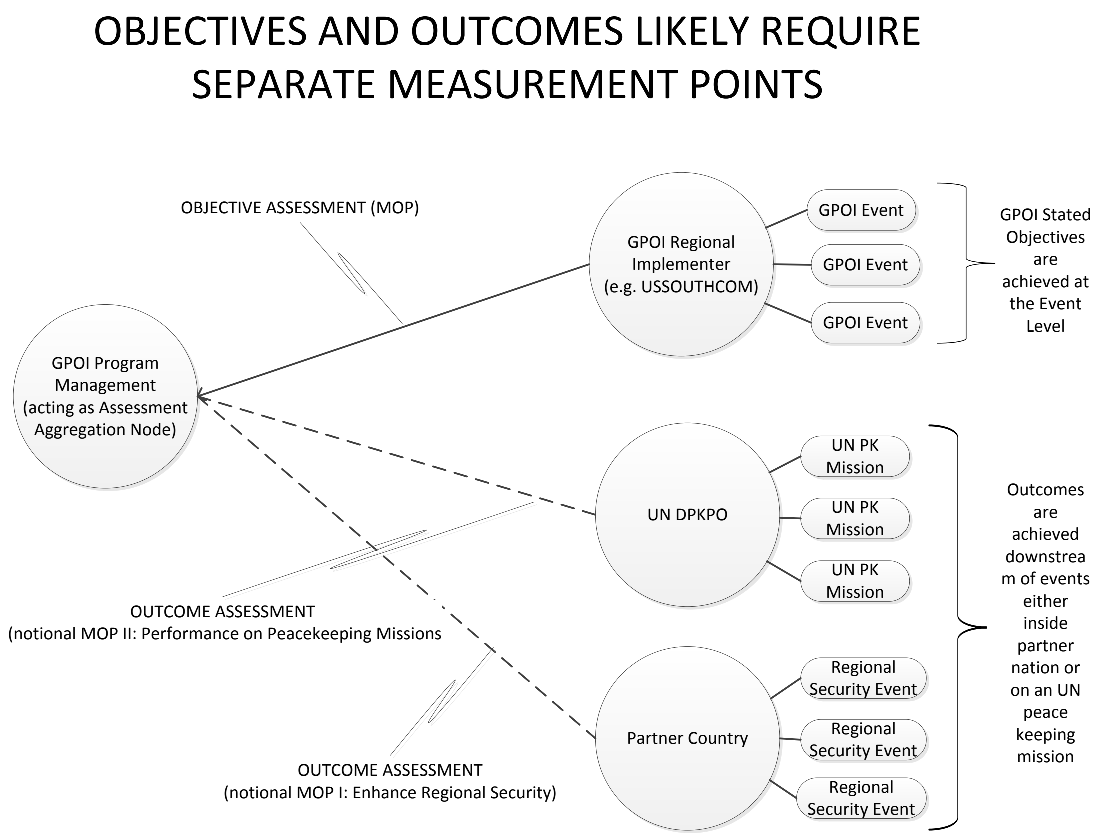

Figure 19. Fundamental Space and Time Difference between Objectives and Outcomes

The outcomes are downstream in the process, and their measurement opportunity is likely at a later time as well as in a different location than the objective measurement. The implication is that the while objectives do achieve the outcomes, they likely require separate measurement. For example, the “Successful Completion of United Nations Peacekeeping Mission” MOE must be measured either on-mission or post mission (which may be some time later and certainly in a different place than where the troops were trained). Essentially, the outcomes must be measured when and where they occur; hence, the proposed needs for separate, but compatible, assessment models that can later be aggregated.

2. Assessment Aggregation

As discussed in the development of the data-based architecture, the nature of the GPOI system necessitates a node that is capable of aggregating assessments. In order to synthesize these assessments, it is important that the supporting models be built with compatibility in mind. What follows is a discussion on a proposed assessment aggregation model and how it could be implemented.

a. Partitioning the Assessment Space

The five required assessment models can be binned based on their expected time periods as well as at their organizational level. Figure 20 illustrates that the assessments be grouped as following: (1) plans and policy assessment, (2) assessments of inputs (MOIs), processes (MOPr), and outputs (MOPs) and (3) outcome assessments (MOE).

Plans and policy assessment naturally occur at the program office level at a defined periodicity. While plans and policy should inform the rest of the process it is unnecessary to reassess every time a GPOI event is conducted. Plans and policy assessment might be undertaken annually, with stakeholders that span the spectrum from oversight to implementers.

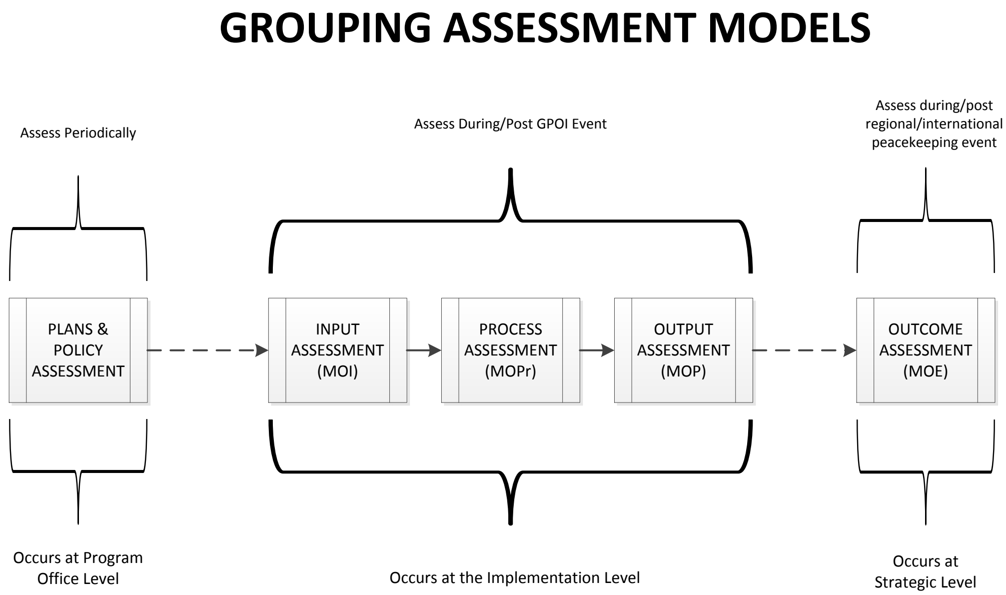

Figure 20. Proposed Assessment Model Partitioning

The second “bin” at the implementer level is understood by measuring the arc of resource input (organizational capacity or financials) through event execution to objective achievement. The implementer bin is explained in greater detail in the following section (see Figure 22).

Finally, and most problematic of all, is the outcome assessment. For reasons already mentioned, this is a fundamentally a different assessment. While other work-around metrics may be introduced as necessary to infer; the desired measurement points will be that of GPOI influenced personnel (e.g., directly trained, equipped or indirectly trained via the train the trainer events) as they perform on assignment in either regional security assignments or on United Nations peacekeeping missions.

The distinct nature of these three groups of assessments precipitates the following: firstly that the assessment models be built as partitioned above so that they will be compatible for later synthesis and secondly that a central node be responsible for the data aggregation.

b. Aggregation at a Defined Node

The previous discussion laid out a notional partitioning, or grouping, of the assessment space. Using the proposed grouping as starting point, an assessment aggregation model can be developed. From this overarching model the supporting models can be derived.

(1) Aggregation Node Assessment Model. A central node should use a model like the one suggested in Figure 21 to bring together the aforementioned three groups of assessments. The central node, which is discussed in more detail later, would be the person, organization, or agency that is assigned the responsibility of synthesis across the measurement space.

The idea is that a diverse set of implementers (such as COCOMS, contractors, and State Department regional bureaus) conduct and assess a large number of events in different partner countries. These events are assessed from the arc of input to objective using a common format and forwarded to the aggregation node. At the aggregation node these events are put against one of the stated end states (outcomes as assessed by MOEs). As previously discussed, the all-important outcome assessment is likely conducted separately. The important feature of the model is that the outcomes as measured are linked back to the objectives that were supposed to realize them, which are in turn linked back to processes (activities) that achieved the objectives, which are in turn linked back to the inputs that enables the processes, which is finally linked back to overarching plans and policy that directs the whole program. (See Figure 21).

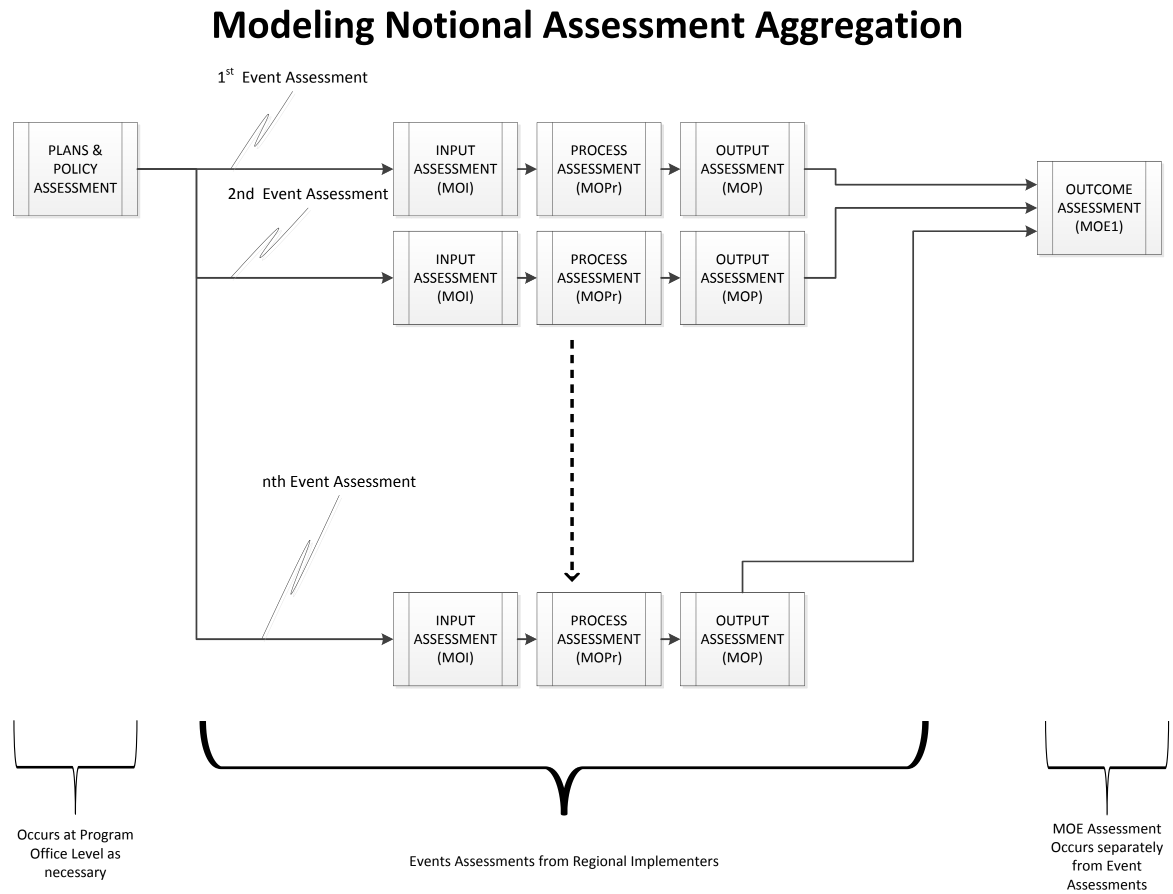

Figure 21. Model of a Proposed Assessment Aggregation

(2) Supporting Implementer Node Assessment Model. Using the proposed assessment aggregation model (see Figure 21) as a basis a notional assessment model at the implementer level is suggested (see Figure 22). The idea is as the implementer set is planning a GPOI event, the assessment model is being built in parallel.

By stitching together an input assessment model, a process assessment model, and an output assessment model. While the outcomes are measured separately, the implementer should indicate which of the stated outcomes is being addressed.

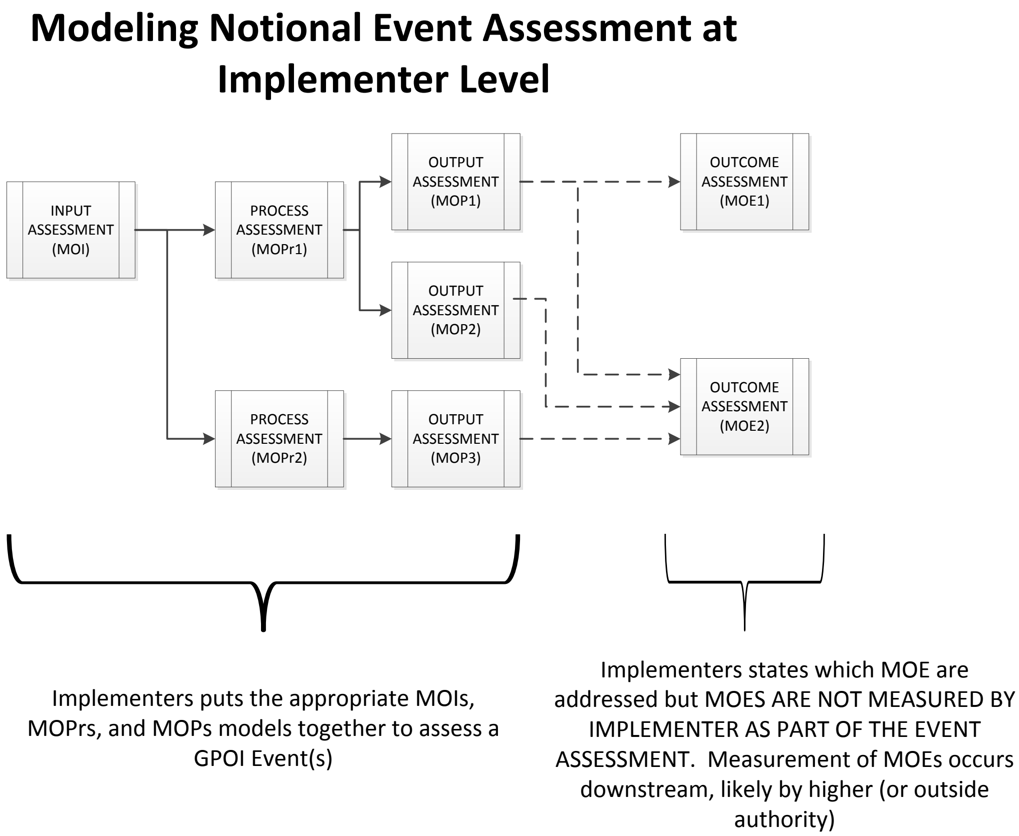

Figure 22. Model of a Notional Event Assessment at the Implementation Level

3. Developing Defined Metrics for the Assessment Models

Realizing assessment models (as proposed in Figures 21 and 22**)** requires one last layer of abstraction, which is assigning specific metrics for each of the defined assessment models. What follows is the proposed basis of specific metrics based on the architecture development.

a. A Note on Metrics: Context and Development Process

The metrics are considered to be a component of a complete assessment framework and not the assessment framework itself. Additionally, as illustrated in Figure 23, metrics should be defined towards the end of the design process to fulfill the assessment models.

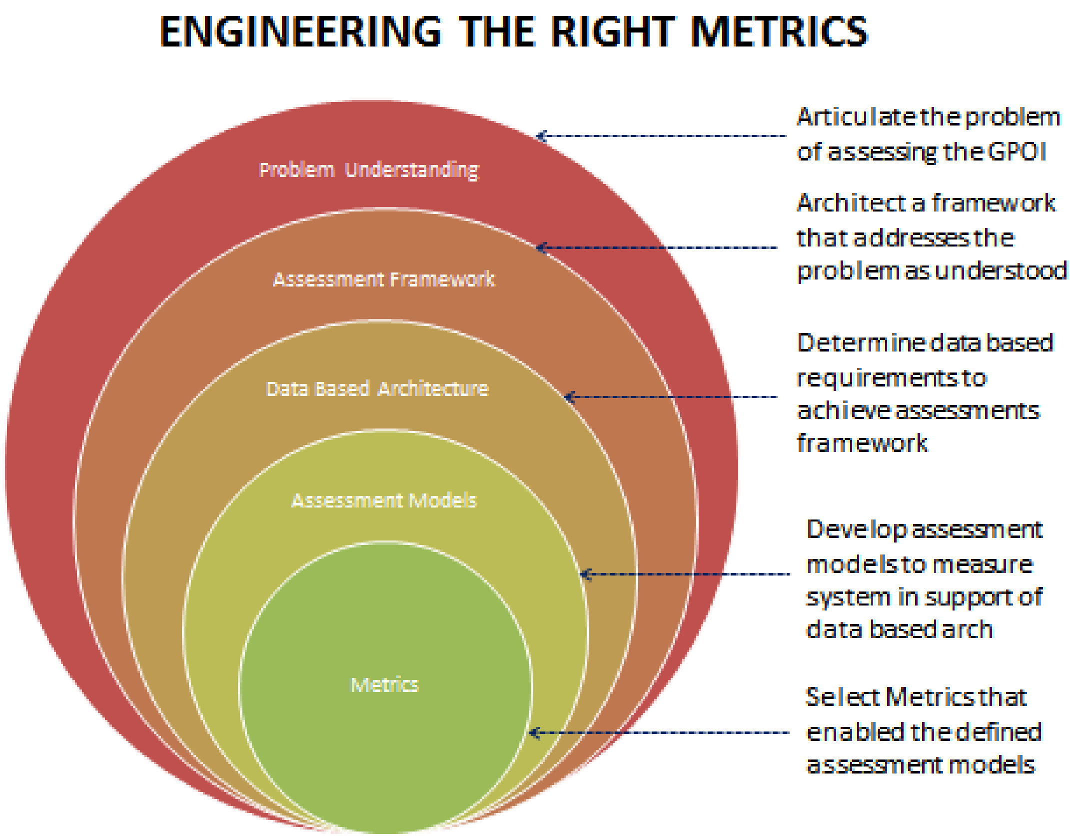

Figure 23. Developing the Right Metrics for the GPOI

The benefit to this design process is that it helps the engineer cut through the clutter of an almost endless list metrics to choose from. By having defined requirements as to what the assessment models should measure, metrics can be chosen in a way that maps back to the original problem understanding.

b. *Metric Selection Basis*

The architecture development informs the metric selection process in two ways. First, it clearly defines the specific points in the system that need to be measured and secondly it addresses what questions should be asked. Using this framework, as expressed in Appendix K, metrics can be assigned.

The takeaway from the proposed metrics requirements is that most of the metrics can be derived from the GPOI program itself. For example, the objectives are made explicit; the MOPs can be built to answer those objectives.

The metrics that will prove the most challenging to develop will be those for the outcome assessment. The difficulty will be choosing a measure of effectiveness that can linked back to stated measures of performance.

B. SATISFYING THE ORGANIZATIONAL ARCHITECTURE

The organizational architecture as developed in Chapter IV (see Figure 16) defines the various nodes in the system by their responsibilities and relationships to one another. To review, nodes are defined as the responsible organization or person that performs the necessary operational activities. The organizational architecture is developed in non-solution specific terms; that is it outlines that someone or some group needs to perform certain actions if the corresponding data-based architecture is to be realized.

The next step in development is to develop a suggested organizational resource management plan that can satisfy the aforementioned organizational architecture. The organizational resource management plan, which should possess coherency with the rest of the architecture, should be realized by a set of memoranda of understanding (MOU) or memoranda of agreement (MOA) between the various agencies. If this last step of codification is completed, then it is more likely that the necessary buy-in and understanding has been achieved throughout the enterprise. Figure 24 illustrates this general approach, which is to drive towards the end state of defined roles and responsibilities as part of the larger systems engineering effort.

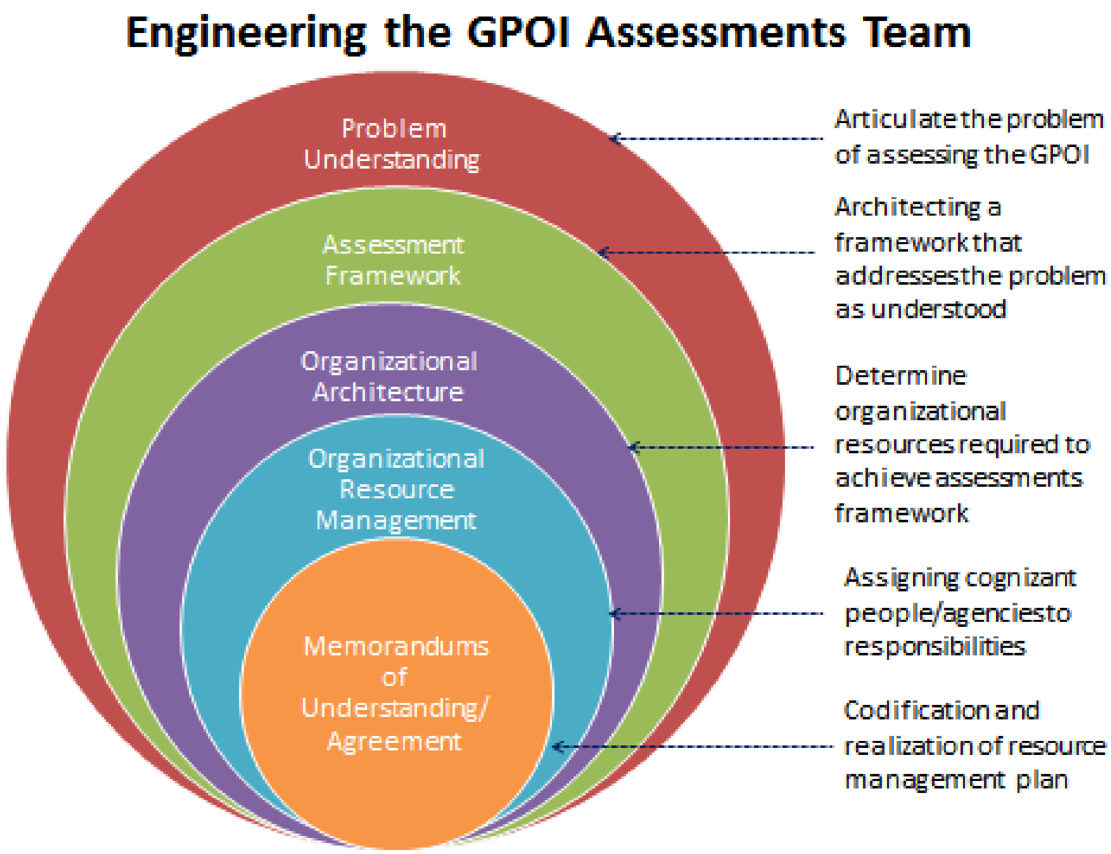

Figure 24. Developing the Right Organizational Resource Application for GPOI Assessments

1. Notional Organizational Resource Management Model

Appendix M proposes specific assignment of assessment responsibilities. The notional assignments are based on the node that is best equipped to carry out the necessary operational activities. The intent is to limit unnecessary duplication of data gathering and analysis or what is commonly referred to in the intelligence community as "stove piping." It is hoped that by leveraging the different views of different nodes within the system that a better assessment can be achieved. This is of course limited by the ability, and will, of the various organizations to partner effectively.

The division of labor as proposed in Appendix L suggests splitting the work across three principal groups. The first group is the GPOI program manager who would be responsible for coordinating the various assessment activities as well as necessary data synthesis. The second group is the implementer set that focuses on arc of money to objective attainment. And the third group is the outside agencies that provide validation assessment. This third group is suggested to be comprised of the UN DPKO to assess the performance of GPOI troops on peacekeeping missions as well as an appropriate agency to assess regional security.

This division of labor can also be viewed through the lens of the SE-V model (see Appendix C). What is proposed is that the program management focuses on the tops of the V, which is the validation level. While the implementer set would focus on the bottom of the SE-V, which is the verification level.

2. A Note on the Use of Outside Agencies

As discussed throughout this thesis, it is firmly believed that assessing the GPOI is very problematic as long as the end states are not made explicit and measured. The first part is less complicated, as logical end states can be translated from the stated mission and linked back to the objectives (see Figure 18). However, as previously discussed it is difficult for an assessments team to measure outcomes as they occur outside the time and space purview of the GPOI (see Figure 19), which is precisely why it is proposed that outside agencies be polled to measure the stated outcomes.

It is suggested that the UN DPKO or other member of the United Nations body be polled for the performance of GPOI trained troops on mission. The case is here is simply is that the end user, and not the designer, who should be the principal evaluator of the system. For less defined notional outcome of "enhanced regional security," it is likely that other members of the US Government will track regional stability. These other US Government entities could be solicited as the basis, at least in part, for an assessment of any improvement or decrement in the region.

The third party assessors of outcomes offer three practical advantages: (1) the third party has the potential to addresses a situation where the GPOI has insufficient access and/or capacity to measure; (2) working with the end-users builds in a feedback loop into the system for continual improvement; (3) as third parties they perhaps have a built in degree of objectivity as to the real "so what" of the GPOI. This likely strengthens the case to be made for GPOI's impact.

C. ADDITIONAL ENABLING ACTUALIZING ELEMENTS

What will really drive the assessments framework is a sound and a complete set of models with corresponding organizational resource management plan to enact them. However, there are likely additional elements that should be developed in order to fully round out and effectively adopt any architecture.

Although not expressly developed in this thesis, what follows is a brief discussion of these additional enabling actualizing elements that would likely require development. They are not developed because they are outside the scope of research, and secondly they are downstream of an agreed upon framework. The principal “other actualizing elements” to be developed and defined would be corresponding processes and procedures and overarching doctrine.

On the processes and procedures issue the idea would be to incorporate any adopted changes of the assessment methodology into the GIG. The most important one would perhaps be the need to include assessment model as part of event planning. Also, the flow of assessments throughout the system would need to be made explicit.

The adoption or reference towards a standing doctrine would be beneficial. This proposed framework is built from SE principles. Grounding in field tested assessment principles would be beneficial to both in the implementation and improvement on any assessment framework. For example, the Army Field Manual 5.0 might be a useful reference to orient the entire team as to role of assessments within the broader context of operations being conducted (The Department of the Army 2012).

VI. CONCLUSIONS, RECOMMENDATIONS, AND FUTURE WORK

The intent of this chapter to take stock of the research conducted and explored four lines of questioning. The first is to examine to what degree the research fulfilled its stated intent. Secondly, the intent is to draw final conclusions, both as they pertain to the GPOI itself as well as those of a more generalizable nature. Thirdly, based on the aforementioned conclusions and totality of the research the intent is to make recommendations to the sponsor for suggested means of improving the assessments for the GPOI. Fourth, and finally, a discussion is offered on how the work contained herein might be advanced by the future research of others.

A. HOW FAR DID THE RESEARCH GET?

The progress of this research is assessed against the stated research questions and objectives. For this thesis a primary research question as well as a secondary research question was posed. Based on those two questions, four SE product specific objectives were developed. What follows is a brief restatement of the original research questions and objectives (see Chapter I) and a discussion as to their level of attainment.

1. Research Question Resolution

The research questions were laid out as a way to give an overall direction for the thesis. They speak to the problem at a high level of abstraction and were intentionally broad as it was unclear how the problem and subsequent solution design would develop.

a. Original Research Questions

The primary and secondary research questions are enumerated below. The first speaks what was thought to have been the chief difficulty in assessing the GPOI, which is its high level of complexity. The second, which was contingent on answering the first, speaks to the assumed need to develop some mechanism to assess the system.

(1) Primary Research Question. The primary research question of this thesis was: can the complexity of assessing the GPOOI be understood and managed?

(2) Secondary Research Question. The secondary research question of this thesis was: Given a structured problem space, how should the supporting assessment models be built?

b. Were the Research Questions Answered?

It is generally difficult to say to what degree the research questions were answered as this architecture is not validated (that is put in use with an opportunity to assess its worth). It would perhaps be more useful to address to what degree the questions were addressed. By answering this question, the groundwork is laid for a cogent future works enumeration.

(1) Was the Primary Research Question Answered? It is difficult to determine to what degree the GPOI complexity is understood and can be managed because there is no answer key. Achieving problem insight was addressed by trying to organize and define its elements and managing its complexity was addressed by offering a series of processes that lent a degree of structure as well as way to improve future iterations.

Problem understanding was attempted via standard SE practices. The different stakeholders with their sometimes competing interests were catalogued. Systems architecting was applied to give the problem space and solution space a degree of structure.

Articulation of the problem, no matter how incomplete, is probably an improvement over none as at least a point of departure has been developed from which a more meaningful conversation between stakeholder and developer can be held. Additionally, while a more robust architecture can most assuredly be developed, the one proposed does lay out what are believed to be major elements and their interaction with each other.

(2) Was the Secondary Research Question Answered? This question was answered partially. The proposed beta framework provides a means to construct the specific metrics that would be traceable to the stated objectives and outcomes. The general approach is believed to be sound as well as the product development to the degree to which it was accomplished. However, the research stopped short of proposing

all of the specific metrics that would be needed, and the framework itself is a work in progress that would likely benefit from some more iterative design. Hence, the focus of future work would be a refinement of the architecture and development of what this thesis would refer to as the fifth and final layer of abstraction, which is the metrics themselves (see Figure 23).

2. Research Objectives Achievement

What follows is a brief explanation of the original research objectives and a suggested evaluation as to the level of their attainment.

a. Original Research Objectives

At the outset of the research, it was determined that the problem and subsequent solution design would be developed using a series of systems engineering processes and systems architecting methodologies. With a general approach in mind, the two research questions were decomposed into four research objectives that sought to translate the problem into a series of SE artifacts that could then be further developed into an architecture and eventually specific mechanisms to actualize a solution. In Chapter I, four research objectives were laid out: Expressing the GPOI as a System, Developing a GPOI Assessments Framework, Developing Supporting Assessment Models, and Recommendations for the GPOI Assessments Program

b. Research Objective Attainment

What follows is a discussion of the four research objectives and an evaluation as to the degree of their attainment

(1) Expressing the GPOI as a System. As mentioned a translation effort was undertaken that attempted to transform understanding of the GPOI from various sources into SE artifacts. However this was primarily done from the specific vantage point of assessing the GPOI. To more fully address the objective of expressing the GPOI as a system, a more ambitious modeling effort should be undertaken. Another thesis was conducted in parallel with this one (see Appendix A) that viewed the GPOI as a system of systems.

(2) Developing a GPOI Assessments Framework. An assessment framework was developed for the GPOI (see Chapter IV). The degree to which it is valid and can be adopted or further refined and then adopted is still to be determined. The architecture was developed via what is believed to be a cogent and clearly articulated methodology.

(3) Developing Supporting Assessment Models. This objective was partially achieved. The supporting models and process for satisfying the architectures of the aforementioned assessment framework were developed. However, specific metrics were not assigned to them. It was decided to place that effort outside of the scope of this research. Assignment of metrics would be best addressed after the sponsor is satisfied with the framework first.

(4) Recommendations for the GPOI Assessments Program. Beyond the proffered framework and supporting models, this thesis did yield specific recommendations for the GPOI assessments program. These recommendations are laid out later in this chapter.

B. CONCLUSIONS

What follows is a discussion as to what are believed to be the most salient conclusions of this research effort as it applies to addressing the need for an approved assessment of the GPOI.

1. Traceability Is Key

Returning to the problem definition phase (see Chapter III) the stakeholders concerns can be summarized as a desire to be able to justify the program and a need to provide a feedback mechanism for course corrections. Both of these concerns require that an arc be drawn between investments (money or other organizational resources) and outcomes or “so what?” questions. To the author’s knowledge there is no other way to accomplish either the justification or feedback mechanism without traceability.

Traceability should be achieved by thinking of a GPOI event as a process (see Figure 14) and measuring it at discrete intervals. It is necessary that all of the measurements have defined linkages. In the proposed model, the inputs (MOI) drive the processes (MOPr), which in turn produces outputs (MOPs), which finally realizes outcomes (MOEs). An effective assessment framework can be articulated in ways other than proposed in this thesis, but for it to be valid, it would likely have to provide for a degree of traceability.

2. Aperture Matters

Whether one is trying to assess a specific assessment element or develop a comprehensive framework, what is often necessary is to take a wider view. By increasing the scope of analysis, other elements and their connections are illuminated. In the case of developing the framework, taking a broader view caused the designer to consider elements such as assessing plans and policies as well as processes. These may be scoped out of the final framework to be adopted, but an intentional exclusion is much preferable to leaving them out due to lack of understanding as to their place in the system.

3. Necessity of Solution Organization

Managing complexity and thinking holistically is difficult. If the designer is to take on a broader perspective, then there must be some mechanism to handle the increased depth (layers of architecture) and breadth (number of elements). Defined frameworks, like the one adapted from Totem in this thesis, are useful in lending structure to an otherwise unwieldy problem.

4. Process and Procedure Matters

While this thesis in not a study in usability, the development of products was done with the end user in mind. The definition of end user that has been used in different contexts is: when taking an extra-system view the ultimate end user of GPOI is the United Nations and the partner nation/region and when taking an inter-system view the end-users of the assessment framework are those persons that occupy the implementer and program management level inside the GPOI.

The end products herein that were proposed are assessment models and a notional resource management model. However, in order to best employ the assessment framework the end users would benefit from clearly articulated processes and procedures. These processes and procedures can be developed easily enough from a completed architecture that should account for both technical and non-technical elements. The benefit of an architecting approach is that keeps the user in mind during the development and hopefully translates to a design that can be better actualized.

C. RECOMMENDATIONS FOR GPOI ASSESSMENTS

The intent of this section is to communicate a series of recommendations to the sponsor aimed at improving the state of assessments in the GPOI. The suggestions are binned into two categories: short term recommendations and long term recommendations. The short term recommendations are those that are believed to assist the sponsor in the foreseeable future if adopted. The long-term recommendations are aimed at the development of a better and hopefully more enduring solution.

1. Short Term Recommendations

The approach as outlined in this thesis aims to take in the problem in its totality and develop a coherent family of solutions. While it is believed that an "engineered" assessments framework would likely be the most complete and defensible, a great benefit can be realized by going after "low hanging fruit." This approach is more of a heuristics or best practices course of action, as opposed to the more rigorous development process as discussed throughout this thesis. What follows is, in the opinion of the author, the higher yield short term course of actions that the sponsor could pursue in order to improve GPOI assessments.

a. Achieve Basic Traceability: Make Outcomes and Objectives Explicit and Then Measure Them

Adopting an overarching, rationally developed framework is the best long term solution. However, based on the ill-defined nature of the current assessments, they can be dramatically improved just by adding a limited degree of traceability.

The first step is to make explicit both what the program hopes to achieve (outcomes) and how it will achieve them (objectives). As discussed in Chapter V, as a point of departure, the two suggested notional outcomes could be adopted (Figure 18). The six stated objectives (Table 1) already trace neatly to those notional outcomes.

With objectives and outcomes made explicit, the next step would be to measure them. The first objective, full training capability, is already being measured, so the other five would have to be addressed. Many of these are being executed and catalogued, but not necessarily aggregated into an overall GPOI assessment. For example, GPOI events in the USSOUTHCOM AOR train peacekeepers (Phase II objective No. 2) and provide support for deploying units (objective No. 3). Both of these events are executed in accordance with GPOI polices and are catalogued in TSCMIS. The point is perhaps the need for another five assessments can be sidestepped by performing a bit of an archeology project and pulling from the databases of past events.

This still leaves the issue of assessing outcomes. While still difficult, it is made achieve able by making them explicit. The State Department should attempt to solicit performance reviews from the UN DPKO for GPOI trained missions. As to the regional security outcome, it is suspected that between the various agencies working in the AOR, perhaps one of them is assessing country or regional security that could be used as an assessment in lieu of an engineered GPOI outcome measurement.

This might indeed be a rough-hewn assessment, but it would allow the program to make statements along the lines of: "the GPOI program executed these events, which achieved these stated objectives, which contributed to the realization of these outcomes as measured." As far as the author is aware, that fundamental connection is generally lacking in the GPOI process. This would be a significant first step in achieving a degree of coherency throughout the process as it would provide justifiable assessments as well as help to re-orient the organization to the centrality of traceability.

b. Elevate Discussion to the Program Management Level

Even modest changes, and certainly significant ones, are unlikely to take root without the buy in from the program management level. The framework as presented in this thesis is reliant on the program management level either conducting or delegating key, enabling functions.

What was suggested in the previous section, basic traceability, as well as the larger suggestion of a framework can be understood as changes in organizational processes. While the bulk of the work will likely occur at the implementer level, it is assumed that policies changes require the buy in from program management.

c. Balance the Technical with the Non-Technical

Throughout this thesis different ways of thinking about the problem have been offered, but if pressed to offer the most useful re-orientation, the author would suggest this: the problem is fundamentally a balance between the technical and the non-technical.

There might be a desire to have a unitary measurement model that, if executed by an implementer, would satisfy the assessment requirements. That of course is principally a technical solution. That line of thinking might lead to a bigger and perhaps a slightly improved "stovepipe."

The degree to which the non-technical solution can be developed is the degree to which the technical problem can be obviated. That is, if other responsible agencies can be tapped for analogous assessment data, then the measurement requirements of the implementer are correspondingly reduced. This is why (see longer term solution) complementary data-based and organizational-based architectures are suggested. But for the short term, any basic inter-agency collaboration, or just use of existing internal organizational resources may yield good benefit.

2. Long-Term Recommendations

What follows is a discussion on the course of action that the author believes the sponsor should consider if they are pursue a more complete and more enduring solution space to the problem of assessing the GPOI. Generally the recommendations can be binned into two categories. The first is a call to reconsider how the problem is perceived. And the second is the suggestion of building a more complete solution, using a clear and defined methodology.

a. Think about Your Thinking

As discussed in Chapter II, the GPOI can be viewed as an unperceivable system; wherein the key attributes of such a system are its immense scope and complexity and opaqueness of many of its underlying interactions.

Recognizing the GPOI for what it is should direct the designer towards a few imperatives. The first is a fundamental need to think holistically. As this applies to GPOI, it is fundamentally difficult to understand any one element without widening the field of view so as to capture its interactions with other elements. The second imperative is the need to manage the resulting complexity.

Thinking at this level of abstraction is more effective with a systems architecting point of view than a pure "engineering" frame of mind. Traditional engineering is more or less an optimization exercise, which as Richard Balling (1999) points out requires a well-defined problem space with articulated constraints. As GPOI is in fact an ill-defined problem, systems architecting is a more appropriate approach, as it gives structure to problem space. And as opposed to traditional optimization, systems architecting seeks more to hold the many disparate elements in balance.

All this is to say that the assessing the Global Peace Operations Initiative is an immensely complicated undertaking. GPOI has this in common large information technology and aerospace projects and could similarly benefit from systems architecting methods.

b. Cooperation as a Major Constraint

As mentioned multiple times, the solution must include an organizational component to complement at least any technical solution. Specifically, the stakeholder set must think in terms of inter versus intra organizational resource management.

Recalling the discussion on limitations, (see Chapter III) realize that any modified assessments framework will likely face significant budgetary constraints. Thus, it is probably not realistic to propose doing more with the same. Instead, doing more (more complete, higher veracity assessments) with more (other partners) is more realistic.

Even if resource constraints did not dictate reaching out to partners, the coordination should be executed for the sake of assessment quality. The stated GPOI mission (and what this thesis notionally refers to as an outcome) is to provide trained troops that can succeed on United Nations peacekeeping missions; should not that outcome be assessed at least in part by the end-user, which, in this system, appears to be the United Nations? The same could be said for the need to measure regional security.

c. Negotiate a Working Framework

Using the framework developed in this thesis as a beta, the framework should be further improved and tailored to the sponsor's needs. The methodology for doing so as previously discussed would be to: validate the problem statement, modify the capability architecture as necessary and then adapt the supporting architectures (functional, data-based, organizational). The end state of a well architected framework should be a coherent set of processes and models that address the desired capabilities.

d. Develop Metrics to Fit the Framework

With a well-defined framework the last step should be to select metrics for the various models. Obvious as it may sound, selecting metrics is not the difficult task; it is selecting the right metrics. The entire point of a well-developed data-based architecture is so that a cogent set of requirements can be developed to guide the selection of metrics that answer the right questions. While this is perhaps the end state for the user, it should be the last step and not the first in the design.

D. FUTURE WORK

The intent of this section is to outline future work that could be undertaken as a series of potential follow on efforts to this thesis. Two main lines of research are suggested. The first is the work that would likely be necessary to advance the sponsor's objectives. The second are more generalizable lines of research that, if undertaken, would yield great benefit to a wider audience.

1. Sponsor Specific Future Work

What follows is a suggested way forward for the sponsor to address the stated problem. Again the problem as stated would be the need for a coherent assessment framework. The sponsor is USSOUTHCOM, but as discussed in Chapter III, any other GPOI implementer and certainly the DOS GPOI program office would benefit from a sound assessments framework.

Assuming the sponsor holds the architecting approach and SE methods to be valid means to address the problem, two principal lines of effort are suggested to further advance the assessment framework as put forth in this thesis: (1) problem articulation and assessments framework validation (2) metrics selection. These lines of effort can be reasonably furthered either by the sponsor in isolation or in conjunction with follow on research efforts at NPS or any other qualified consultant for that matter.

a. Problem Articulation and Assessments Framework Validation

As discussed in the recommendations sections, the sponsor should use the proposed framework as a beta or a point of departure to develop a robust and validated architecture. This can perhaps be effectively carried out by another consultant (preferably someone with a systems thinking orientation) who could manage the refinement of the architecture via the iterative design process (see Figure 3).

The idea is that this thesis's work impacts the sponsor's thinking to the degree that the requirement set can made more precise and explicit; the improved problem understanding aides the developer in designing a better supporting architecture.

b. Model Development and Metrics Selection

When the sponsor is satisfied with the state of the problem articulation and the subsequent architecture, the next focus area should be building the necessary models to fill out the assessments framework. Beta models are offered as a point of departure, but will likely require adaption depending on the direction of the architecture.

2. Future Work to advance Assessment Theory

What follows is a brief discussion of future research topics that would be generalizable to applications outside of assessments in GPOI. These broader topics could be explored by using the GPOI as a use case.

a. Exploring the Linkage between MOPs and MOEs in Assessment Development

For the most part throughout the design process there were well developed paradigms or methodologies that were employed directly or adapted to the problem at hand. For example, during the problem definition phase a series of standard SE practices (stakeholder analysis, functional analysis, articulation of scope, boundaries, limitations, etc.) were used to give the problem some structure. Also during the architecting phase there were several frameworks or paradigms that were used as a starting point from which to build an assessments framework (this thesis used an IT model, see Figure 9). However, when the actual models were being developed, a glaring hole in understanding became obvious: maintaining traceability from measure of performance (MOP) to measure of effectiveness (MOE).

As it occurs in this instance, and as it is suspected to occur in many others, there is a fundamental break in space and time in achieving and in measuring objectives and outcomes. In the GPOI example the objectives due in fact link to the notional outcomes (see Figure 21). What is unclear is, assuming both MOPs and MOEs can be assessed: how does the analyst differentiate between causation and correlation when measuring effects in such a complex system?

This is a problem for assessing a complex system, or as specifically labeled in this thesis an unperceivable system. In acquisition, there would be developmental testing for verification (MOPs) and operational testing for validation (MOEs). But in a problem set like GPOI where the assessment is complicated by being part of such an intricate system, it would seem the causation piece (that is maintaining traceability and hence validity of the assessment), is very problematic.

b. System Dynamic Modeling

It would be helpful to have more literature on the subject on how such a complicated system could be modeled and better understood. At one point in this thesis's development, the idea of using dynamic modeling to evaluate the various interactions was considered. There is readily available software to explore the system along these lines, such as Stella (IEEE Systems 2014).

A follow on researcher could take on this challenge and use the Global Peace Operations Initiative as use case. The understanding would perhaps yield valuable insight both to a real world customer as well as potentially shedding light on new ways to model and understand such systems.

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APPENDIX A. OVERVIEW OF GPOI ASSESSMENT PROJECT TEAM

A. RESEARCH TEAM ORGANIZATION

The research team is an interdisciplinary team composed of students and faculty from multiple departments. The vision is to leverage different perspectives from separate academic groups in the hopes of being better equipped to prosecute what is undoubtedly a difficult research problem. Students from both the Modeling, Virtual Environment and Simulation (MOVES) Institute and the Systems Engineering Department are participating at both the master's and doctoral student level.

The intent is for the doctoral candidate assigned to this project to assist in advising the master's thesis while at the same building understanding of the problem for follow on PhD dissertation work. Thus, the master's thesis (of which this report is one) is intended to be part of the foundational work of both future dissertations and theses. The longer appointments of the faculty advisors and PhD candidates provide continuity to the problem, while the shorter term master's students provide a continual source of new perspectives.

It is hoped that the practical advantage of this organized team methodology is to allow NPS to tackle a difficult and relevant real world problem in a concerted manner that otherwise would be beyond the scope of any one single thesis or dissertation.

B. SYNERGISTIC RESEARCH EFFORTS

At the time of this writing another master's thesis on the subject is being conducted in parallel. While the thesis is also concerned with GPOI assessments, the research focus is fundamentally different and as such it is hope that the two efforts will offer unique understanding. Additionally, the beginnings of a PhD dissertation are also being laid out on the topic of assessment that as previously stated will seek to leverage the work of the master's students.

C. RESEARCH PLAN

Figure 25 depicts the high level timeline that places this thesis in context of the broader research effort. This thesis is primarily focused on architecting an assessment framework with associated measurement models. Additionally, another SE master's student is analyzing GPOI from a systems of systems view while a MOVES PhD student is concurrently building his proposal.

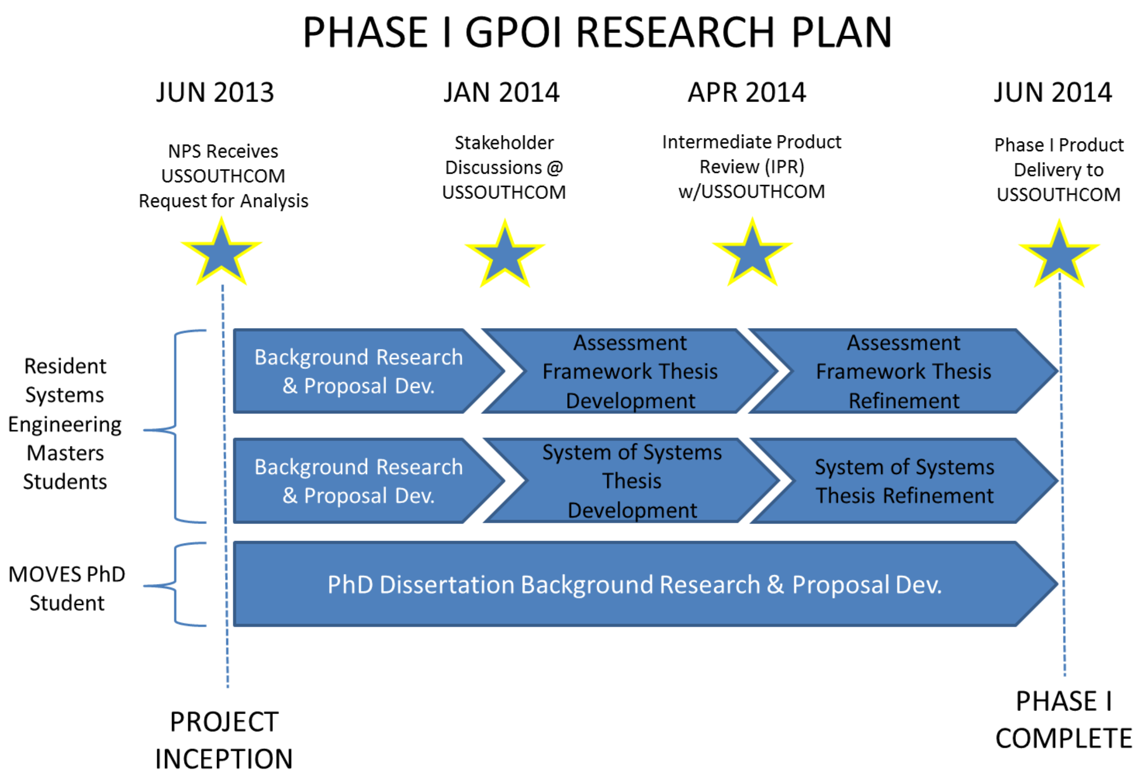

Figure 25. GPOI Phase I NPS Research Team Schedule

The aforementioned research plan references phase I (from which this thesis was conducted in), however a follow on phase is planned. Phase II will have a similar structure of resident master's students conducting focused research concurrently with the development of a PhD dissertation. The general theme of phase II will be building upon the foundational systems engineering efforts of phase I and apply modeling and simulation methods to further enhance understanding and yield higher fidelity products.

In phase II the sponsor will have an opportunity to refocus the requirement set in light of the understanding gleaned from phase I. The researchers will be benefited by groundwork already laid as well as a less compressed scheduled as the effort will not be starting from a standstill and will have a longer period of time in which to work. A notional phase II schedule is expressed in Figure 26.

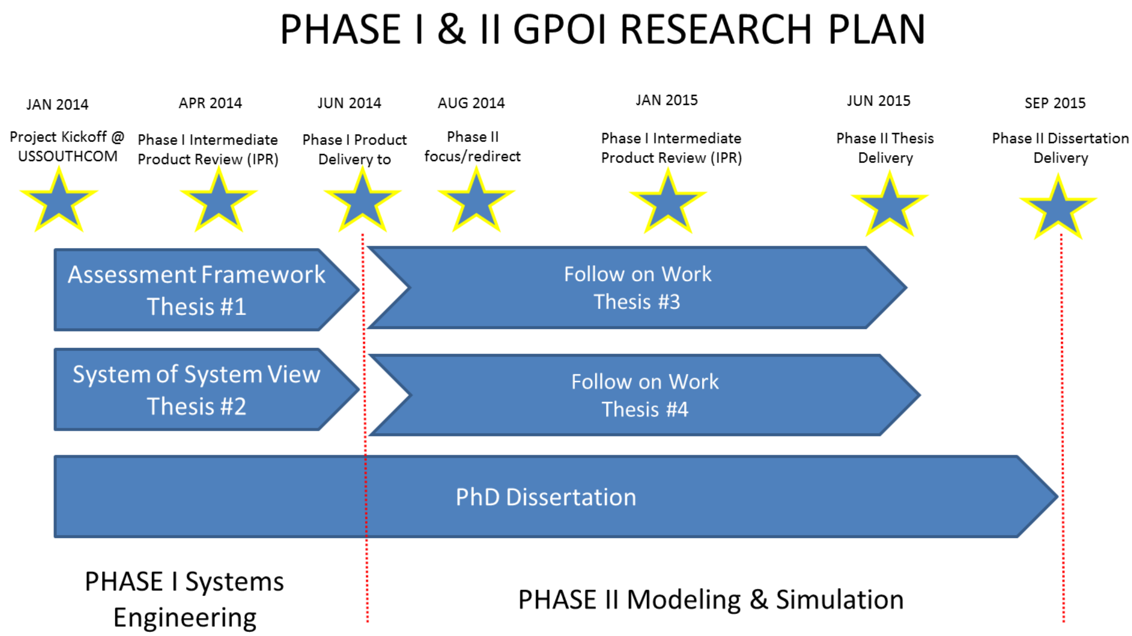

Figure 26. Notional Phase I & II Research Schedule

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APPENDIX B. MODELING PROCESS

What follows are the key elements from the modeling process as proposed by Paul West, John Kobza, and Simon Goerger (2011). This general framework was applied throughout the thesis as a general methodology for thinking about and constructing models and architectures. Their process was also helpful in pointing out limitations and potential for improvement of this thesis's proposed models to include the need to work iteratively and recursively and the eventual goal of verification and validation.

A. CREATING A CONCEPTUAL MODEL

The conceptual phase is concerned with the enumeration of all of the elements that are to make up the model such as inputs, outputs, measures, relationships, processes. After articulation, diagramming helps to further flesh out the necessary elements (West, Kobza and Goerger 2011).

B. CONSTRUCT THE MODEL

The construction phase is carried out by choosing an appropriate modeling paradigm (IDEF0, FFBD, SYSML, UML, etc.) and representing the elements and relationships from the conceptual phase (West, Kobza and Goerger 2011). This formalizes the models and adds mathematical coherency. Clarity of presentation was the principle factor in choosing modeling language.

C. EXERCISE THE MODEL

Model exercise speaks to verification and validation of the model (West, Kobza and Goerger 2011). This would require a degree of data entry and ultimately real world operational testing.

D. REVISE THE MODEL

Revision speaks to the inherent flexibility of a model (West, Kobza and Goerger 2011). Once created engineers and end-users should be able to update the models throughout the lifecycle. As this thesis introduces explicit models to GPOI assessment process, revision is outside of the scope and will be left to future research and end-users.

The Modeling Process (according to West, Kobza and Goerger 2011)

Create a conceptual model
- Identify the purpose of the model
- Identify the input variables
- Identify the output measures
- Indentify the components of the system
- Identify controls
- Specify assumptions
- Identify relationships and interactions
- Draw a diagram of the system
- Create a flow chart of the system

Construct the model
- Choose a model type
- Represent relationships

Exercise the model
- Verify
- Validate
- Accredit

Revise the model (model-test-model)

APPENDIX C CLASSIC SE V-MODEL

Figure 27 is a representation of the well-known Systems Engineering V-Model (Clark 2009). It explains both “top down” and “reverse” engineering processes for systems. The illustrative point, as it pertains to the Global Peace Operations Initiative, is that if the assessments framework is operating only at the verification level, both in its design and implementation, then it has effectively cut out the customer requirements as well as ultimate end state of the system. Hence the goal is to architect a framework that is end to end and expresses the arc of desired outcomes to measured outcomes.

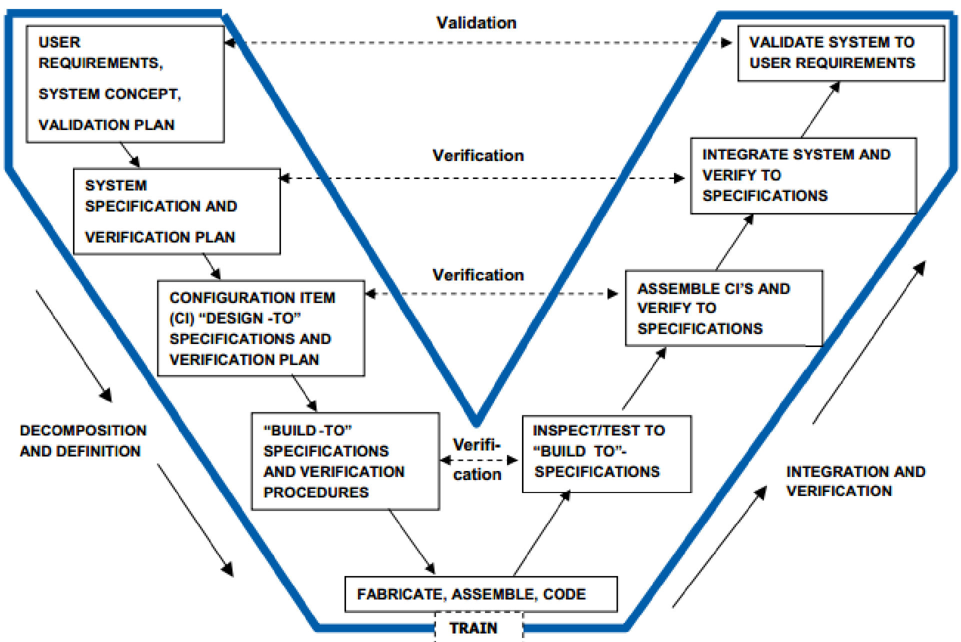

Figure 27. Classic Systems Engineering V-Model (from Clark 2009)

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APPENDIX D. GPOI PHASE I OBJECTIVES

PHASE I GPOI OBJECTIVES	
1.)	Train and, as appropriate, equip at least 75,000 peacekeepers by 2010, with an emphasis on Africa;
2.)	Enhance regional capacities and support institution building;
3.)	Support the G8 Africa Clearinghouse and establish a G8+ Global Peace Support Operations Capacity Building Clearinghouse;
4.)	Support the development of a G8 Transportation and Logistics Support Arrangement;
5.)	Develop a cached/deployment equipment program;
6.)	Support Italy’s Center of Excellence for Stability Police Units (COESPU); and
7.)	Conduct self-sufficiency and sustainment efforts in support of all activities listed above

Table 2. Phase 1 GPOI Objectives (after U.S Department of State n.d.)

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APPENDIX E. HISTORICAL FUNDING LEVELS FOR THE GPOI

GPOI HISTORICAL FUNDING LEVELS BY FISCAL YEAR	
FY05	$96,666,000
FY06	$100,384,000
FY07	$81,000,000
FY08	$96,442,437
FY09	$105,900,000
FY10	$96,900,000
FY11	$98,800,000
FY12	$91,850,000
FY13	$75,000,000

Table 3. GPOI Historical Funding Levels Represented as Congressional Appropriations (after Bureau of Political-Military Affairs and Office of Plans, Policy and Analysis 2013)

The tables are from the State Department's *GPOI Implementation Guide* (Bureau of Political-Military Affairs and Office of Plans, Policy and Analysis 2013)

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APPENDIX F. FIRST ORDER STAKEHOLDER ANALYSIS

Stakeholder	What the stakeholder requires from GPOI Assessments	What GPOI Assessments requires from the Stakeholder	Assessment Resources	Risks if they are not engaged	Unique Concerns	Impact/Influence on GPOI Assessments
US State Dept (PM) (implemter) (policy)	Traceability. The State Department needs to understand how a dollar in the GPOI program translates towards achievement of a stated outcome. At the program manager level future investment guidance is needed.	(1) Accounting Data (2) Plans, Policies,Strategy, Processess and Objectives (3) Overarching assessment frameworks (4) Enterprise support	(1)GPOI Program Office Staff (2) In country embassies	(1) Unable to achieve an overarching assessment framework (2) Lack of enterprise coherency	(1) Ability to justify impact of program on the hill with pertinent data and sound analysis (2) Sensitive nature of assessments, particarly for a diplomatic agency	High/High
USSOUTHCOM (implementer)	Understanding. The individual combatant commanders require an understanding of how GPOI events count towards his or her lines of effort.	(1) Execute In country assessments (2) detailed documentation of GPOI events executed	(1) In country mil-groups (2) Organic CoCOM assessment capability (J8)	(1) Inability to achieve all necessary high fidelity in country assessments (2) Inability to maintain objective-outcome linkage	Is GPOI beneficial? Does it address theatre needs or extra-thearte needs?	High/Med
Participating GPOI Nations (subject matter)	(1) Guided Investment (2) Training Certification	(1) Access to required system measurement points	(1) Self-reporting mechanisms	Loss/restriction of access. High fidelity assessments become difficult	Funding that results in capacity and capability	Med/Low
United Nations DPKO (end user) (potential data source)	Unit Readiness. The UN requires understanding as to the state of readiness of potential units to fill peacekeeping force quotas	(1) Operational Performance of GPOI supported units	(1) Organic on mission assessment and evaluation resources	Potenial loss of important outcome measurements	Privacy of Information (e.g. protecting member nations from potential embarrasment)	Low/Low

Table 4. First Order Stakeholders for GPOI Assessment

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APPENDIX G. GPOI EXPANDED FUNCTIONAL HIERARCHY

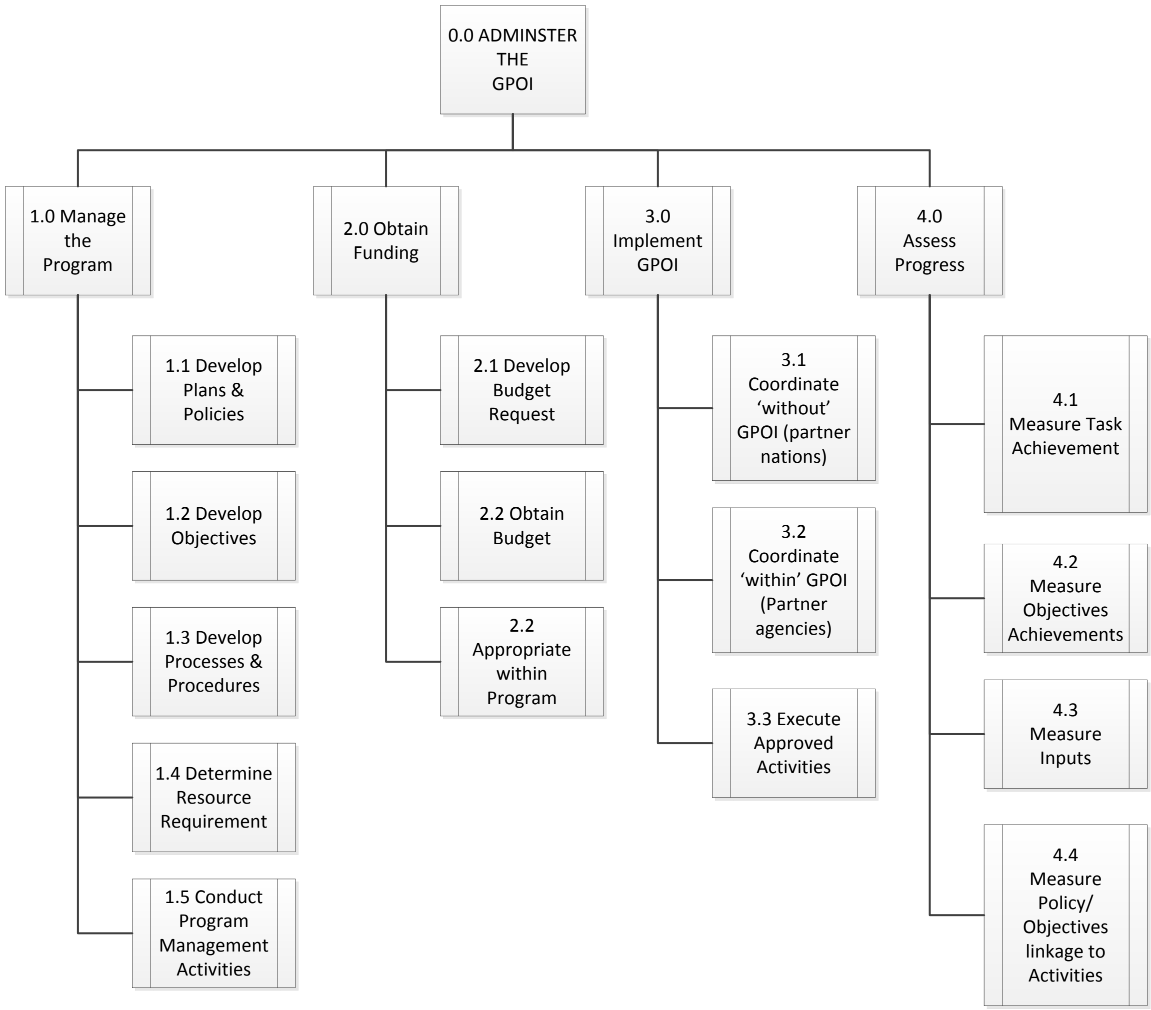

Figure 28. Expanded GPOI Functional Hierarchy

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APPENDIX H. GPOI DATA FLOW DIAGRAM

Figure 29, a working data flow diagram (DFD) for GPOI assessments, is an intermediate abstraction used by the modeler to begin thinking about the nature of the connections of the stated system functions (Buede 2000). The DFD was used to facilitate the translation of the functional hierarchy (see Figure 5) into a defined functional model (see Figure 6) (Trainor and Parnell 2011).

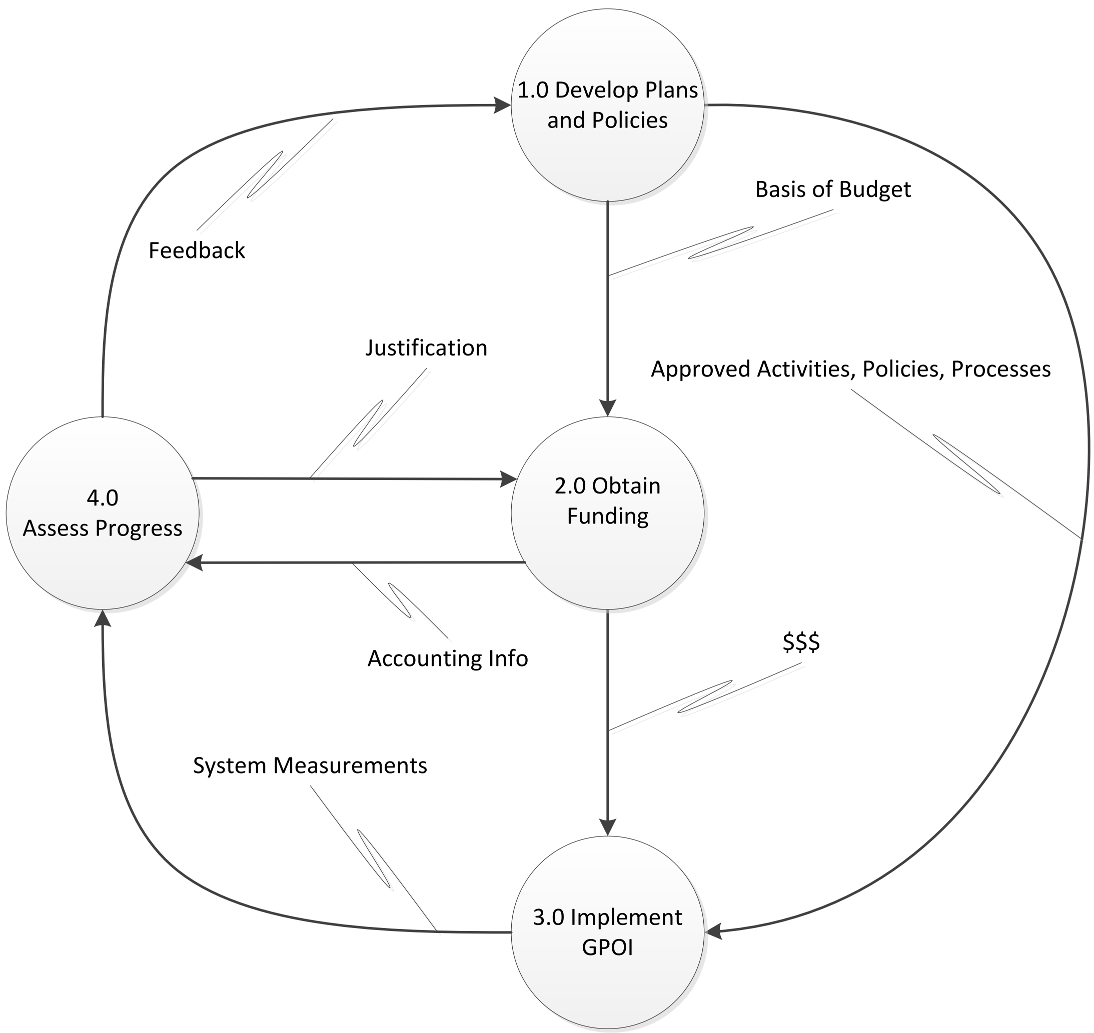

Figure 29. Working GPOI Data Flow Diagram

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APPENDIX I. IDEF0 PRIMER

IDEFO was used for functional modeling in this these was primarily used for clarity of presentation. On the clarity front IDEF0 focuses on the relationships of functions or activities in a way that represents a larger process. As this thesis is concerned with understanding how the assessment function operates within the greater organizational process of the GPOI, IDEF0 is a natural choice.

IDEF0 links functions or activities together by defining the nature of their connections. The connections of each function are categorized in four bins: inputs, outputs, controls, and mechanisms (see Figure 30). The output is what the function is required to achieve with respect to the rest of the system. The input is what the specific function requires to execute its activity. The mechanism is the entity (e.g., person, organization, and equipage) that will carry out the function. Finally, the control are the conditions or set of conditions required to achieve the desired output (e.g., policies, approval criteria) (Software Engineering Standards Committee of the IEEE Computer Society 1998).

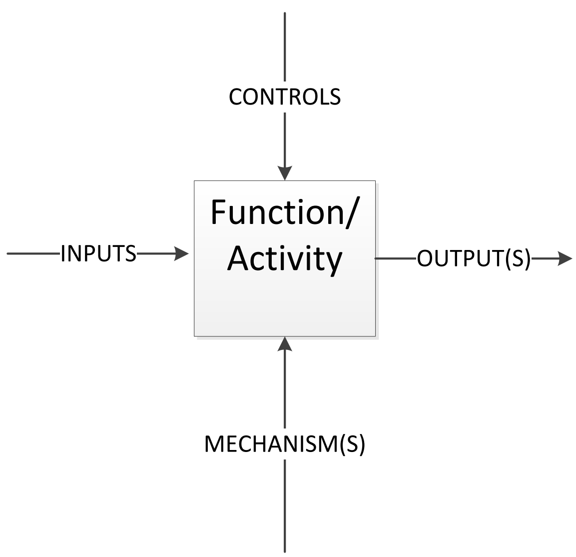

Figure 30. Basic IDEF0 Structure

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APPENDIX J. FUNCTIONAL ANALYSIS DISCUSSION

The functional analysis (see Figure 9) produced a series of system level requirement and insights that will be helpful in architecting a suitable assessments framework (as developed in Chapter IV). Again, these insights are caveated as being valid to the degree with the functional analysis is sound.

A. DESCRIPTIVE UNDERSTANDING

As mentioned in Chapter I, every product can be binned into two main product families, prescriptive and descriptive. Prescriptive products propose modifications to the system. Descriptive products articulate the “as is” or “should be” condition. The IDEFO functional model in Figure 6 is a descriptive product as it was built based on the understanding of GPOI operations based on program policy.

If the sponsor believes the model to be deficient, then either the model itself is not expressed properly or the real world practice is perhaps lacking (or both). In the former case, the solution is to of course amend the model and thus a more useful abstraction of organizational process is achieved. If in the latter case, that is practice does not conform to policy, then the sponsor should evaluate policy and/or the organizational processes being implemented.

B. MEASUREMENT BASIS

The functional analysis offers very intuitive logic chains. The first is that policy is the starting point from which objectives are built, from which activities should be based on. This offers clear traceability and basis of measurement. Most importantly it is offered that the outcomes of the events activities should be measured against the stated objectives. Even the objectives themselves can be measured based on the articulated overarching policy.

C. ROLE OF ASSESSMENTS

Within the system the assessment functions serves as feedback mechanisms. The use of the information is different depending on which is activity is consuming the assessment. For example perhaps the "Obtain Funding" function would use the assessments as justification before Congress. The implementer set could use the information as a performance assessment as to how impactful they are actually being. And for the strategic function, the assessment exists for strategic redirection and program modification. While different nodes in the system will use the assessment differently it is offered that they all require the fundamentally same data set.

The implication is twofold. The first is transmission. If the assessed information is not being properly promulgated for higher system use then it does not matter how good the assessment is. The second is the type of information. It does not suffice, of course, to just do an assessment. As previously mentioned what is required is the right information that shows traceability and hence causality.

If the wrong information is being collected or perhaps the right information is not properly disseminated through the system then the assessment function essentially becomes what is referred to as a "self-licking ice cream cone." In other words if the framework is not set up to extract specific forms of information and then communicate them to the other nodes then the assessment activity will in effect be an untethered function that is not serving the broader system properly.

D. IMPORTANCE OF MEASUREMENT VARIETY

The model as proposed shows the assessment function measuring various parts of the system. The implication is that a variety of information will likely be required to generate sound assessments. This is of course not a profound statement, but is none the less made to emphasize the importance of extracting the right information from the right parts of the system.

There need not necessarily be a large quantity of information gathered, just the right information. To paraphrase Robert Michael's analysis of assessments conducted in the Iraq and Afghanistan conflicts, excessive and extraneous information is detrimental.

There is perhaps a temptation to measure what can be readily measured, but this should be avoided in favor of attempting to measure what is required. (Michael 2010)

E. CONTROLS AND MECHANISMS

One of the benefits of modeling a system in IDEF0 is that forces the SE to consider carefully the controls and mechanisms required of each function; the notion that functions or activities by definition have controls and mechanism is a defensible enough. That is every function must be executed by some entity (mechanism) and it usually does so under some level of guidance or constraint (controls). Thus is it offered here that for the assessment function within GPOI the mechanism would be the assessment personnel themselves (which are of course drawn across multiple levels and agencies). The control would be the assessment framework. The assessment framework would be the policies and process governing assessments as well as the assessment models themselves.

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APPENDIX K. GPOI ASSESSMENTS OPERATIONAL CONCEPT

Figure 31 is an operational concept graphic or OV-1 of Assessments in the Global Peace Operations imitative. An OV-1 is a defined view in the Department of Defense Architectural Framework (DODAF). The OV-1 is meant to convey the big picture of a systems actualization to a wide audience. There are of course many more elements and relationships that could be included and defined, but the intent is to convey a high level view. For the system's architect this is a useful intermediary view to begin thinking about the system (Dam 2006).

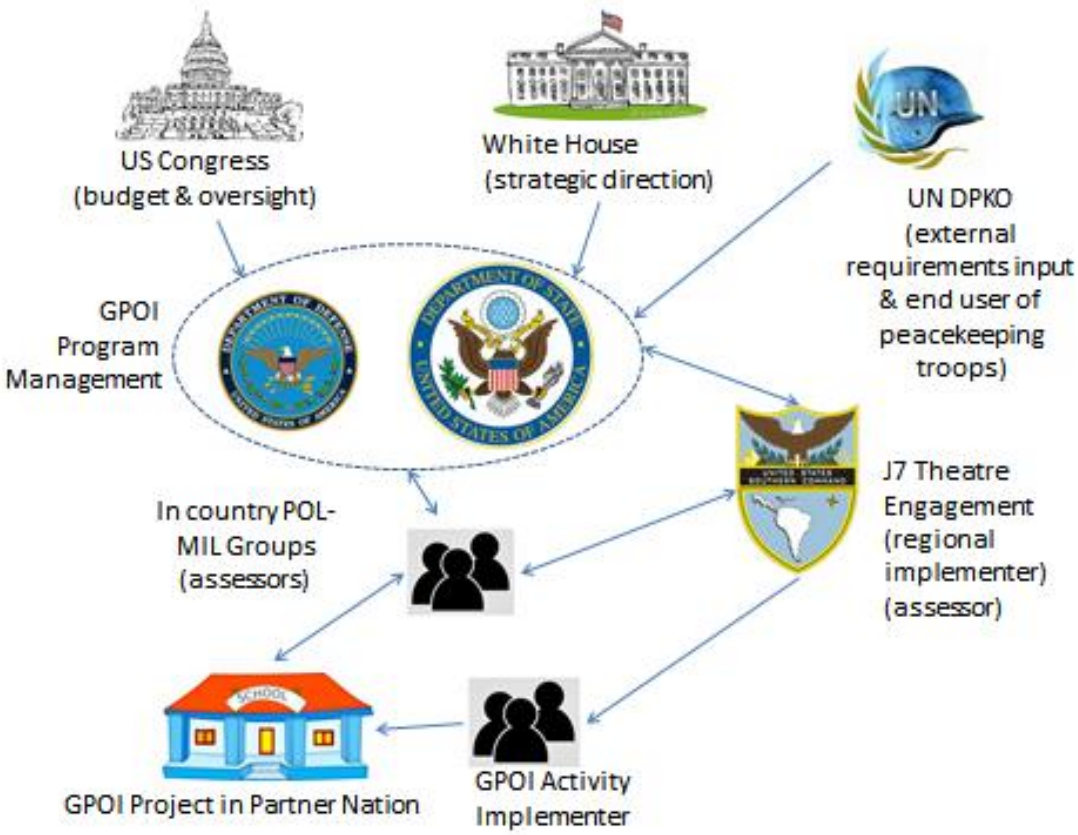

Figure 31. GPOI Assessments Operational Concept (OV-1)

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APPENDIX L. WORKING METRICS REQUIREMENTS DOCUMENT

1. Define Metrics for GPOI Models
   1.1. Define Metrics for Plans and Policy Assessment—This requirement is achieved by having a defined capability to assess whether GPOI is articulating the correct high level policy to govern the program as well as whether or not the stated processes and procedures align with the policy as articulated.
      1.1.1. Define Metrics for Assessing for GPOI Policy and Objectives——The question to answer: is the high level GPOI policy correctly articulated in view of higher level national policy directives and international agreements?
      1.1.2. Define Metrics for Assessing GPOI Processes & Procedures—The question to answer: (1) Are the stated processes and procedures in accordance with GPOI policy? and (2) are the missing processes and procedures that need to be made explicit?
   1.2. Define Metrics for Input Assessment—This requirement is achieved by the capability of quantitatively assessing the input or the cost of the GPOI program
      1.2.1. Define Metrics for Measuring Monetary Input—the question to answer is: How much does the event, or element, of the GPOI cost?
      1.2.2. Define Metrics for Measuring Organizational Input -The question to answer is: how much organizational bandwidth was consumed by conducting the event? Recommended to either monetize this value or represent as an opportunity cost
   1.3. Define Metric for Process Assessment—This requirement is achieved by the capability of assessing how a particular event conformed to stated policy
      1.3.1. Define Metrics for measuring adherence to stated processes—The question to answer is: was the event conducted in accordance with GPOI policies and procedures?
   1.4. Define Metrics for Output Assessment—This requirement is achieved by the capability of assessing how a particular event, or series of event, achieved stated objectives:
      1.4.1. Define Metrics for Assessing Achievement of Objective #1—The question to answer is how did the event contribute to the partner country achieving FTC?
      1.4.2. Define Metrics for Assessing Achievement of Objective #2—The question to answer is how did the event contribute to training peacekeepers?
      1.4.3. Define Metrics for Assessing Achievement of Objective #3—The question to answer is how did the event contribute to providing support for deploying units?
      1.4.4. Define Metrics for Assessing Achievement of Objective #4—The question to answer is how did the event enhance the peace operations capacity of regional/sub regional organizations and institutions?

1.4.5. Define Metrics for Assessing Achievement of Objective #5 –The question to answer is how did the event establish or strengthen the institutional infrastructure and doctrinal framework to train, equip, and deploy FPUs?

1.4.6. Define Metrics for Assessing Achievement of Objective #6—The question to answer is how did the event support the continuation and enhancement of multilateral approaches/partnerships to coordinate peace operations capacity building efforts?

1.5. Define Metrics for Outcome Assessment—This requirement is achieved by the capability of assessing the level of outcome attainment.

1.5.1. Build Metrics that link back to Stated Objectives

1.5.1.1. Define Metrics for Assessment of Notional Outcome #1—The question answer is how has regional security been enhanced?

1.5.1.2. Define Metrics for Assessment of Notional Outcome #2—The question to ask is: how successful were the GPOI trained units on of UN peacekeeping missions?

APPENDIX M. NOTIONAL ORGANIZATIONAL RESOURCE MANAGEMENT MODEL

GPOI Assessments Organizational Resource Management

Node*	Responsibilities	Notional Assignment
Assessment Aggregation	(1) Coordinate assessment activities (2) synthesize all system	GPOI Program Manager
Plans & Policy Assessment	(1) Verify processes and procedures are in accordance with stated plans and policy (2) Verify plans and policy in accordance with higher level plans/policy/directives	GPOI Program Manager
Input Assessment	(1) Assess Cost of GPOI Events	GPOI Implementer in cooperation with USD program office
Processs Assessment	(1) Verify events conducted in accordance with procedures	GPOI Implementer
Output Assessment	(1) Measure objective attainment (x6) of events	GPOI Implementer
Outcome Asssessment	Assess two notional outcomes: (1) enhancement of regional security and (2) succesful execution of United Nations Peacekeeping missions	GPOI PM via GPOI End-Users: UN DPKO for assessment of degree of success on peacekeeping missions and outside agency for regional security assessments
Dissemenation Control	Determine responsible consumers of GPOI assessments as well as appropriate classifications	GPOI Program Manager
Assessment Consumption	End users of GPOI assessments	Various: As determined by dissemenation control
Analysis Cells	Intermediate activities that consume GPOI assessments in context of broader concerns and provide analysis to decisionmakers	Various: As determined by dissemenation control
Metric Development	Responsibility to contiunally revise and update assessment framework and associated models and metrics	GPOI Program Manager

*From the Defined List of Nodes from the Organizational Based Architecture (see Figure 16)

Table 5. Notional Organizational Resource Management Plan

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